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THE COLUMBIA BICYCLE.

THE bicycle furor which pervaded this country and Europe a few years ago has subsided into a solid interest in this means of locomotion, which is much more noticeable in England than in this country, although the bicycle is now very popular here, and is daily becoming more so. It has arrived at great perfection, and is constructed more scientifically than formerly. It is of great practical utility as well as a rational means of amusement. It is, in fact, an ever-saddled horse that eats nothing and requires no care.

Undoubtedly the most perfect bicycle now made is the "Columbia," manufactured by the Pope Manufacturing Company, of 87 Summer street, Boston, Mass. This machine, which is shown in our engraving, has a steering head which is one solid forging. The backbones, which are made of steel, are large, light, strong, and rigid. The spring is attached by a joint to a small plate sliding on the backbone. The wheels are of the spider pattern, with steel V-shaped fellies, with forged steel hubs, hardened in bearing parts. The back wheel and pedals run on coned bearings, one being adjustable, and are made so as to prevent the admission of dust and dirt. The front wheel bearings are conical and well hardened, and fitted with coned fastenings. The India rubber is 1 inch on the front and ¾ inch diameter on the back wheel.

In the modern bicycle the seat is placed almost directly over the center of the front wheel, by which means a much larger wheel can be ridden, thus gaining in speed and making the act of propelling it more like walking, instead of pushing with the feet as in the velocipede, which is tiresome and injurious to the rider. Although our bicyclists have had very little experience compared with English riders, yet some long distances worth mentioning have been made. On November 27, 1877, Mr. A. D. Chandler rode from Leominster to Boston, a distance of 40 miles, in 4 hours. May, 1878, Russell Sharp and John Storer, from Boston to Newport, R. I., 72 miles, in 13 hours, including stoppages. Actual riding time, 10½ hours. August, 1878, H. E. Parkhurst rode from Clinton to Boston, 44 miles, in 5½ hours, without a stop, making the distance from South Framingham to Boston, 20½ miles, in 2 hours. Has also ridden from Boston to Natick and return, without a dismount, 36 miles in 3½ hours. October 15, 1878, E. W. Pope and F. S. Jaquith rode in the suburbs of Boston, 77 miles in 11 hours, including stops. After having ridden 60 miles they made the distance from Wellesley to Newton, over 7 miles, in 38 minutes. October 19, 1878, G. R. Agassiz, on the Chestnut Hill road, traveled one mile in 3 minutes 21½ seconds, winning the Boston Bicycle Club Gold Medal. E. Costen and F. Smythe, September 2, 1876, on a turnpike road, made 205 miles in 22 hours.

THE COLUMBIA BICYCLE.

We give a record of some professional and amateur bicycle runs made in England:

Quickest professional times—October 2, 1876, J. Keen, Molineaux Grounds, made 1 mile in 2 minutes 56 1-5 seconds. Same party, December 8, 1876, Lillie Bridge, made 10 miles in 33 minutes. Same rider, on same date and place, 20 miles in 1 hour 5 minutes 34 seconds. The same, October 9, 1876, Lillie Bridge, 50 miles in 3 hours 6 minutes 45 seconds. October 19, 1874, D. Stanton, Lillie Bridge, 106 miles in 7 hours 58 minutes 54 seconds. The same, March, 1878, Agricultural Hall, London, 1,000 miles in 6 days.

Quickest amateur times—T. T. East, Lillie Bridge, 1 mile in 2 minutes 56 seconds. September 11, 1875, W. Tylerson, Lillie Bridge, 10 miles in 34 minutes 40¾ seconds. May 15, 1876, Hon. I. K. Falconer, Cambridge University Grounds, 50 miles in 3 hours 20 minutes 37 seconds. June 10, 1878, F. E. Appleyard, turnpike road, Bath to London, 100 miles, in 7 hours 18 minutes 55 seconds. Stanley Thorpe, turnpike road from London to York, 105½ miles, in 22½ hours.

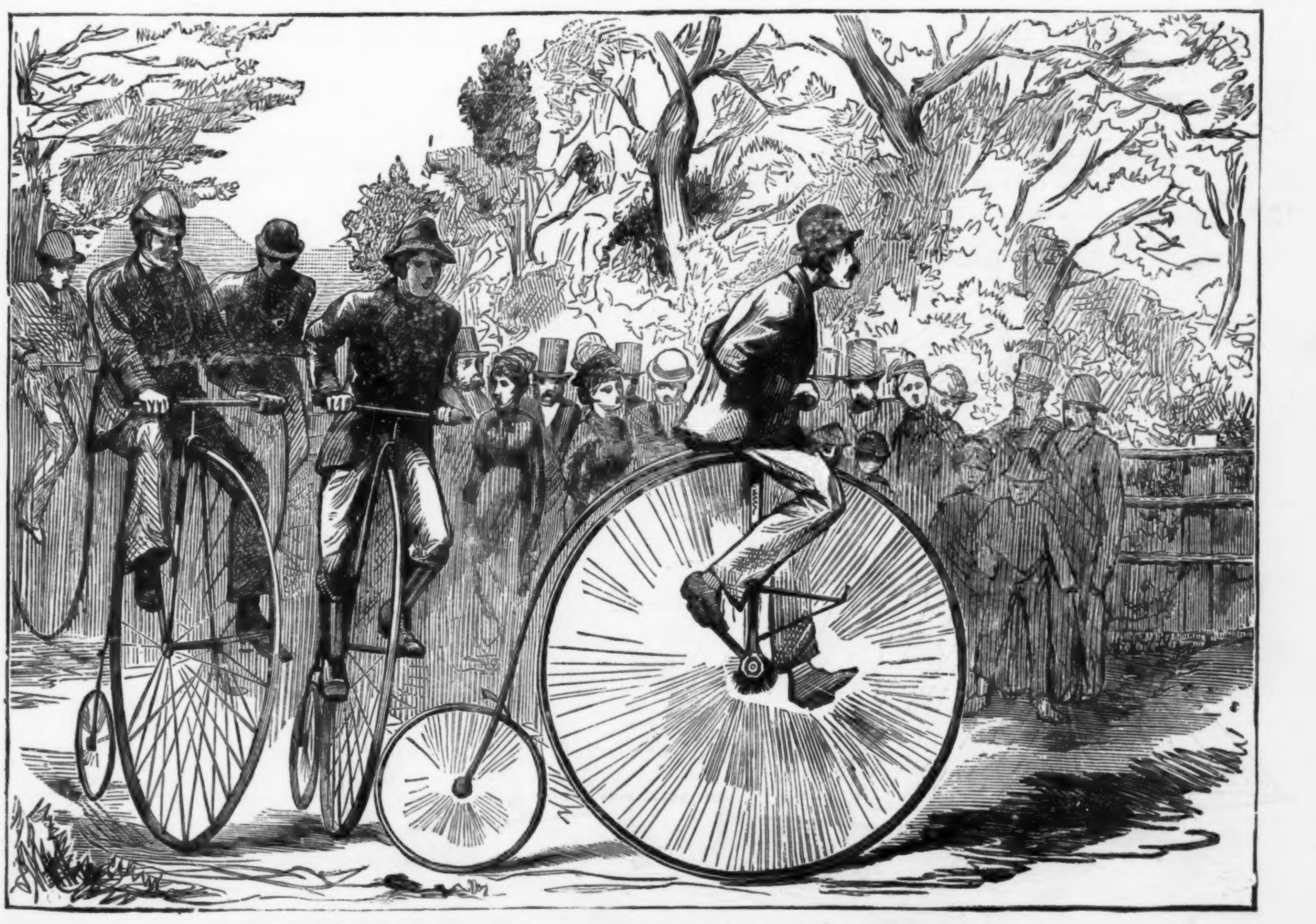
THE BICYCLE IN AUSTRALIA.

Our sketch is from the *Illustrated Adelaide News*, and shows the opening turnout of the Melbourne Bicycle Club in November last. The Club is in a very flourishing condition, its members are provided with best and latest styles of vehicles, and in some of their runs have made very remarkable speed.

A MEDICAL OPINION OF BICYCLING.

The following remarks are the result of the practical experience of a physician, who is also a bicyclist:

The first beginning is by no means easy work, the exertion required to keep one's balance being considerable, and the beginner, when he has had half an hour's lesson, will be in as great a state of fatigue as an experienced rider who has



OPENING TURNOUT OF THE MELBOURNE BICYCLE CLUB.

finished a long race. The lessons should be taken easily, and for short periods at first, so that the learner may get used gradually to the unwonted effort, and then in a very short time practice brings ease and enjoyment in place of very hard work

A very usual mistake is for bicyclists to ride machines which are too large. The advice of good and experienced riders—never to have the leg at full stretch when riding—is amply borne out by surgical experience. In choosing a bicycle the rider should ascertain that the *middle* of his foot, *under the instep*, touches the treadle during the *whole* of its revolution. In that case—as the ball of the great toe is the proper part to tread with when in action—the knee need never be quite straight, and consequently the hip-joint also is a little bent. This is of great consequence, as the strain upon the groin is considerable when the leg is forcibly straightened, and there is liability to rupture.

Another reason why it is dangerous to ride a bicycle with too long a tread is that, when the legs are obliged alternately to be at *full* stretch, the pressure of the saddle comes mainly on the front part of the fork, where it is least easily borne; in fact, it is like riding on a rail. The body ought to be supported on the broad seat, and should rest on the hinder part of the saddle, not on the narrow part of the front, and it is impossible to avoid such a mistake if the treadle be not easily within the reach of the rider during the whole of its revolution.

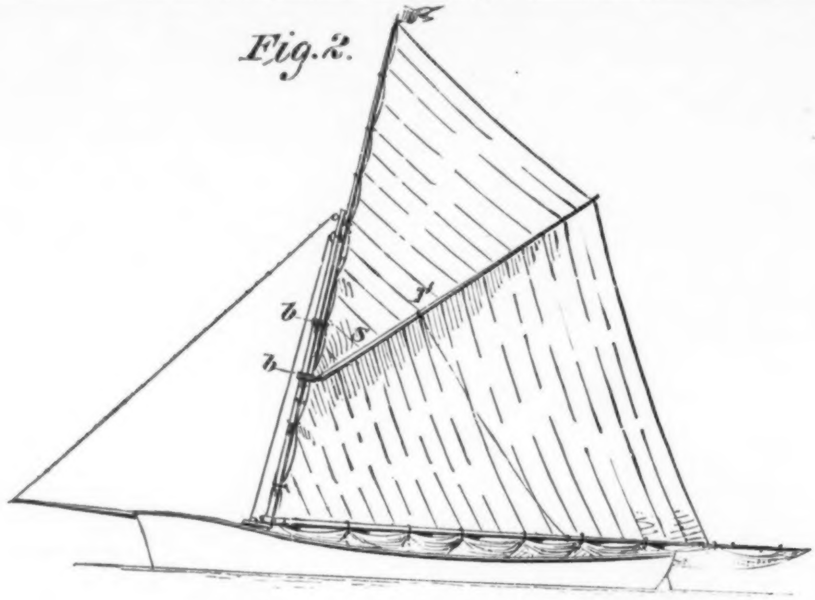
Having given these words of warning, the more pleasing task remains of pointing out the advantages which may be derived from this modern mode of locomotion. It would be almost impossible to invent any exercise more calculated to call into play every muscle of the body than bicycling does. The simple act of pointing the toes, as in standing on tiptoe, calls into play something like a dozen muscles of the foot and leg; then the leg cannot be moved either backward or forward without using some powerful muscles which are attached to the trunk. The whole leg is at work in propelling the bicycle, and every muscle of the arms and body is constantly at work in retaining the balance and guiding the machine.

The slight delay occasioned by dismounting to walk up hills is amply repaid by the rest (by change of movement) which is thus obtained between the periods of action. A rider may be sure that he is using too much exertion when he can hear or feel his heart beating (for no one ought to be conscious of the possession of a heart), or when he is at all short of breath; under either of these conditions, he ought either to diminish speed considerably, or still better, to stop and rest.

Regular exercise, in some form or other, is essential to the good health of everybody. It is impossible to estimate how much biliousness, gout, indigestion, accumulation of fat, and various other maladies are engendered by giving up active exercise. The boon of being able to mount the "iron horse" and get a peep of country and a breath of fresh, pure air is immense to those who are employed all day in large towns, and who, but for this steed, could not get away far enough in the time they have to spare after work is done.

Bicycling is too firmly established as a recognized and favorite means of locomotion to be in the least danger of dying a natural death. Only let it be carefully used, and not abused, and the benefits to be derived from the exercise will be incalculable. Improvements in construction are presented to the public almost every month, and, without doubt, there will be still many improvements. Possibly the friction will be in course of time reduced to such a slight degree that the present ease of riding will be greatly augmented.

Fig. 2.



NEW BOAT RIG.—SINGLE REEF.

A NOVEL BOAT RIG.

By H. R. TAYLOR, Machias, Me.

IN boat-sailing one great danger lies in the uncertainty of quickly lowering a mainsail. Large craft have weight of "top-gear," crew, and space, enabling them to clear an accidental "hitch." Not so with the smaller class of sail-boats. With them, perhaps, in the boat-yard or at the slip, their various "rigs" work admirably, but in *practice*, at a critical moment, their sails, unlike Crockett's coon, *will not* "*come down.*"

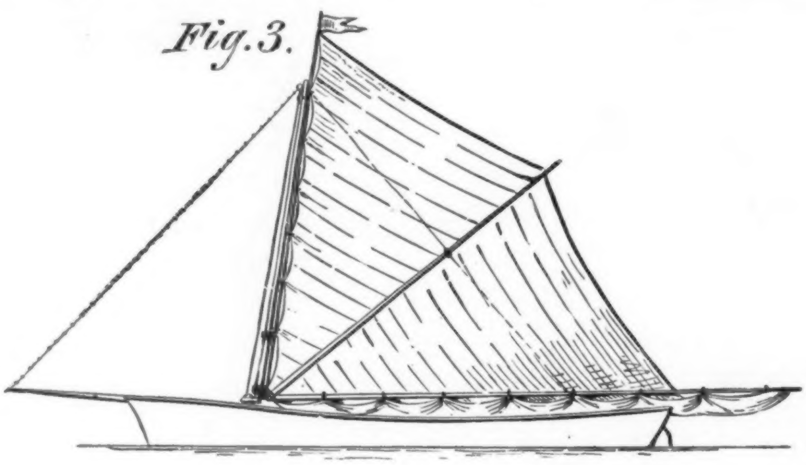
Ignoring "down-hauls" (which usually get foul in such exigencies), *some one* must run forward and "claw down the muslin," provided the boat is not meanwhile "swamped" or upset.

Having to some extent observed these difficulties, nine years ago I designed and applied to a little yacht called "Star of Evening," the rig, which will be understood by accompanying diagrams and descriptions.

After thorough trial, during these nine years, in all phases of yachting, subjected in our down-east weather and waters to "fitful gusts of tortuous rivers," to sudden squalls of bluffs and headlands along our coast, from Passamaquoddy to Mt. Desert, among islands, tide-ups, eddies, chop-seas, and "long-rolls," we have ever found it safe and reliable, many times saving a "capsize" or "swamp," when perhaps *no other rig would.*

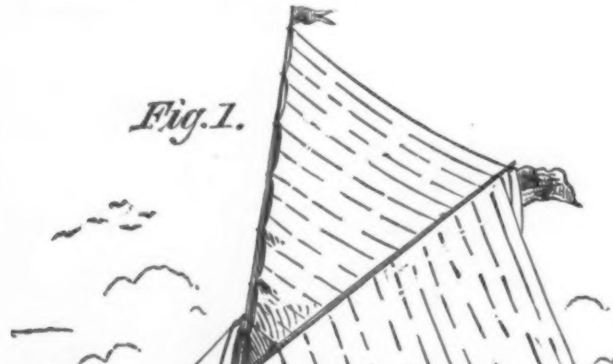
It is well known that, in scudding before a strong wind and heavy sea, more care and skill is requisite than upon any other point of sailing. Especially is this so with an open or undecked boat. At the moment of descent into the "trough" between two high waves, the sail, when reduced or "reefed down" is for an instant "becalmed," so that before headway is regained a combing wave may dash over

Fig. 3.



NEW BOAT RIG.—DOUBLE REEF.

Fig. 1.



NEW BOAT RIG.—FULL SAIL.

Fig. 4.

NEW BOAT RIG.—SAILS BRAILED.

the stern, and "foundering" is inevitable. In such cases this peculiar rig is unequaled. With one hand upon the tiller, the other may quickly raise or lower the sail, as "trough" or "crest" of waves may render necessary. It might, perhaps, appear "like working one's passage," but it has in more than one instance proved our salvation when dangerous condition of tides, obstructed channel, proximity of ledges, or sudden squalls obliged us to run in a given direction.

The peculiarity of this rig consists in having a "sliding" topmast, to which the upper portion of the mainsail is fastened, the lower portion being fastened to three mast

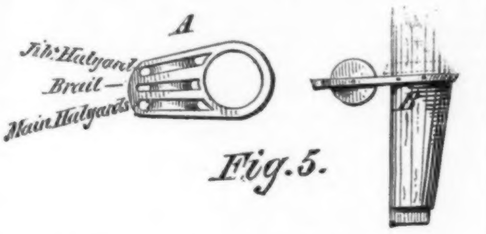


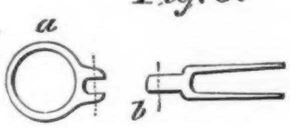
Fig. 5.

hoops in the ordinary manner. A single halyard leads from the lower end of the topmast over a sheave in the end of the lower-mast, thence down before the mast to another sheave near the foot of mast, thence aft, where a "cam-catch" (*a*, Fig. 8), instead of the usual cleat or belaying-pin, secures it in such a manner that a single touch (with the foot, if hands are occupied) will loose the halyard and the sail drops as required.

The topmast slides easily up and down the lower mast, being secured to it by two flat bands or hoops of brass, *b b*, Fig. 2. The sail is made whole, although the folding sprit, S, gives it the appearance of having a gaff-topsail. This sprit is hinged to the foot of topmast, so as fold up close to the mast when boom and sail are brailed up as in Fig. 4.

A ring or "traveler," T (Fig. 2), having a small sheave or "dead-eye" through which the brail passes, moves easily

Fig. 6.

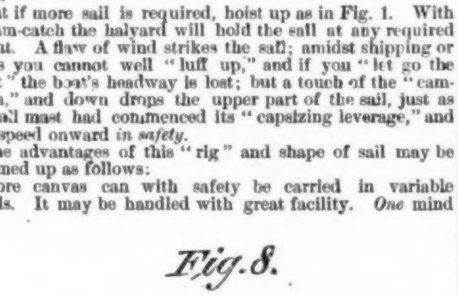


up or down the sprit, in order that the brail may always keep in fair direction for topping the boom or reducing the sail.

The metal portions are all brass or copper, lightly made, yet of requisite strength. The boat (centerboard) quite sharply built, is copper fastened, seventeen feet long, and four feet six inches wide. A space of about three feet is divided off in the stern exclusively for the helmsman, and for coiling away the main and jib halyards, sheets and brail, each being led aft under the thwarts out of the way of any obstructions.

In fair weather or foul, gentle breeze or "stiff nor'wester," we have our craft under perfect control, and, without moving from our seat, make or take in sail *ad libitum*. Suppose we push off from the landing with sail brailed up, as in Fig.

Fig. 7.



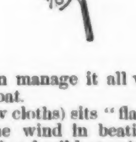
4, we slacken the brail, and the boom with foot of sail will drop to the gunwale, as in Fig. 2, or may be checked part way for reduced sail, and in strong wind, if desired, "reefed" there.

But if more sail is required, hoist up as in Fig. 1. With the cam-catch the halyard will hold the sail at any required height. A flaw of wind strikes the sail; amidst shipping or rocks you cannot well "luff up," and if you "let go the sheet" the boat's headway is lost; but a touch of the "cam-catch," and down drops the upper part of the sail, just as the tall mast had commenced its "capsizing leverage," and you speed onward *in safety*.

The advantages of this "rig" and shape of sail may be summed up as follows:

More canvas can with safety be carried in variable winds. It may be handled with great facility. *One* mind

Fig. 8.



and pair of hands can manage it all without disturbing the equilibrium of the boat.

The sail (of narrow cloths) sits "flat as a board," enabling it to lie close to the wind in beating, while "before the wind" the "rolling" and wild steering will be lessened, for the reason that the greatest volume of sail and its highest part is made more central, and, if necessary, *lower down*, while "dipping" of a boom is impossible, for, with the brail, it may be "topped up" out of reach of the waves.

The "rig" often supersedes "reefing," as it is almost "self-adjusting," especially when the wind is one or more points "free."

The jib-sheets are double, or one on each side leading beneath the gunwale of the boat to cleats aft. A down-haul and halyard likewise lead, so as to enable the jib to be hauled down or set from the stern.

DESCRIPTION OF DRAWINGS—SCALE FIVE FEET TO THE INCH.

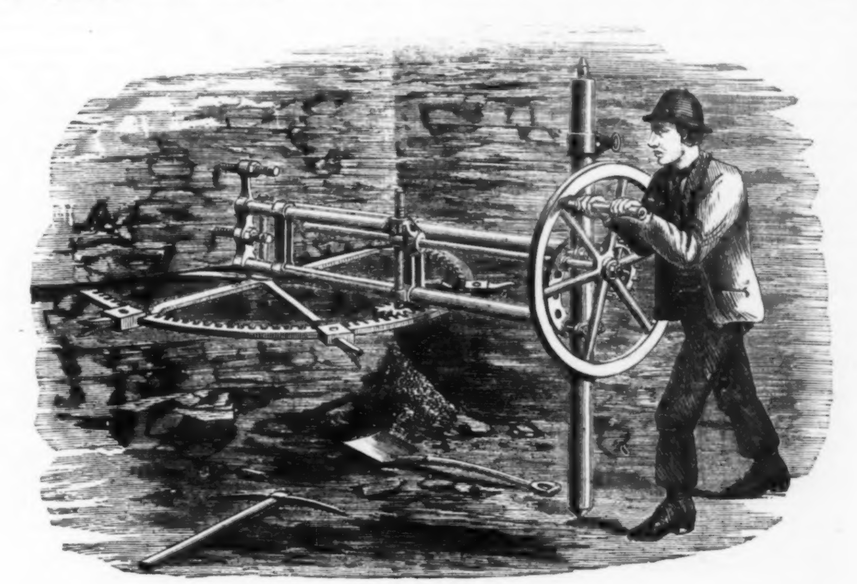
Fig. 1 shows mainsail and jib as set for light winds.
Fig. 2, mainsail partially dropped.
Fig. 3, topmast wholly lowered down.
Fig. 4, sail brailed up with boom close to mast.
Fig. 5 A, plan view of brass casting, showing its upper side, with sheaves for brail, main, and jib halyards. Its collar slips over the mast and is fastened to it with brass screws, as shown in position at B, forming a "saddle," upon which the collar of the boom (*a*, Fig. 6) freely turns. Instead of having "jaws," or an ordinary "goose-neck," the boom is secured, as shown at *b*, Figs. 6 and 7.
Fig. 7 also shows in dotted lines the saddle and main sheave with portion of halyard.
Fig. 8, the "cam-catch" adjusted near the boat stern directly in front of steersman, for securing main halyard.

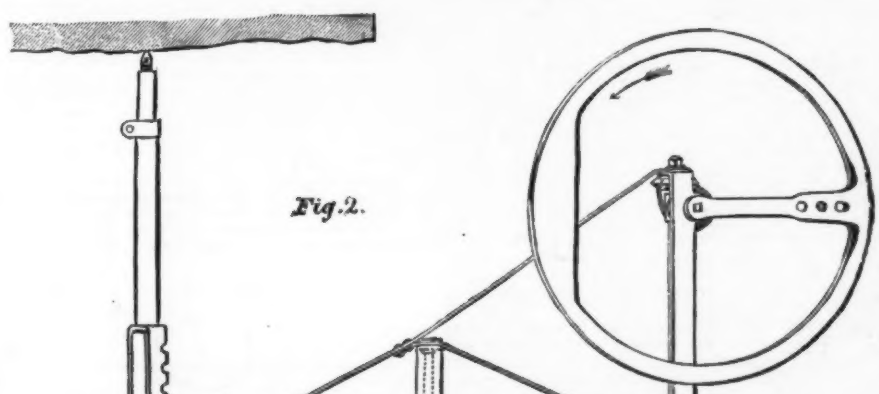
Dimensions.—Length of lower mast above gunwale, 10 ft.; diameter in largest part, 4 in.; the foot is squared and fitted to a brass socket or step in the keelson; length of topmast, 12 ft.; length of sprit, 11 ft.; length of boom, 17 ft.

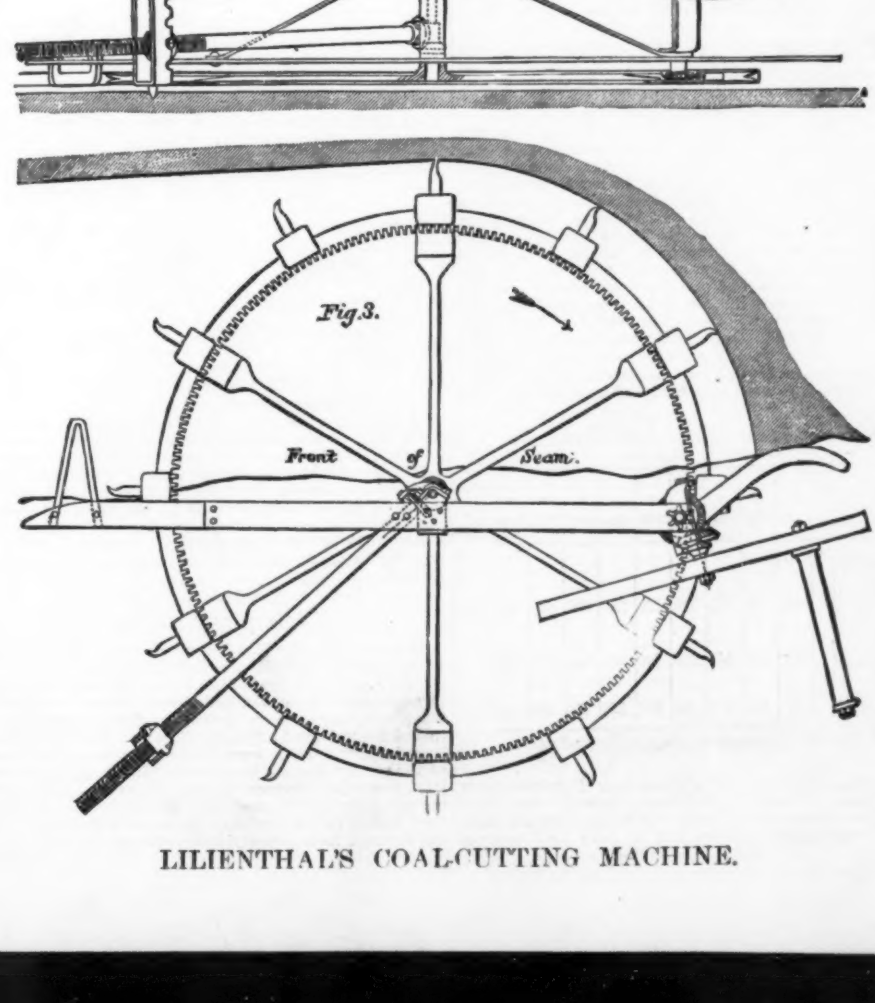
The sheaves in Fig. 5 may seem proportionally large, but freedom of motion is insured thereby. The outer ones, for main and jib halyards, permit the latter to run on each side of the mast, but the brail being in the center, requires a hole through the mast sufficiently large for it to run freely.

COAL-CUTTING MACHINE FOR MANUAL POWER.

WE give herewith illustrations of a small coal-cutting machine, designed by Mr. Otto Lilienthal, of Berlin, and which has been used for some time under very varying circumstances, and with very satisfactory results in different mines in Germany, Austria, and Hungary. The machine is of such construction that two men can easily transport it and erect it in any place in the mine, even in very narrow and low headings. In consequence of this the machine seems particularly adapted for those workings in which the small space available particularly increases the severity of ordinary hand labor. The great simplicity of the machine







LILIENTHAL'S COAL-CUTTING MACHINE.

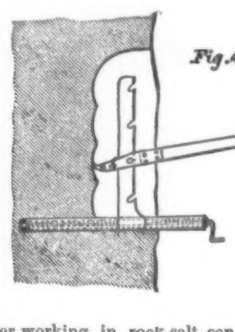
has, doubtless, had a material effect in leading to its quick adoption in practice.

In Fig. 1, previous page, we give a perspective view of the machine in operation; the cutting wheel, which revolves and is slowly traversed forward, thus entering the coal, is carried on a slide, mounted upon the frame, which is firmly kept in position between a column and the face of the coal. The manner in which rotary motion is applied to the wheel will be easily understood from the illustration, while a spindle carried at the back of the frame and receiving an intermittent motion from the crank wheel, produces the requisite forward traverse of the cutting wheel into the coal. The cutting wheel carries six cutters $1\frac{3}{16}$ in. wide, these producing a cut the depth of which from the face depends on the diameter of the wheel. The frame of the machine is made of gas piping welded together, thus combining lightness with strength.

The area cut by the machine greatly depends upon the quality of the coal, and in some measure also upon the space available for working; in narrow headings two men cut in hard coal about two yards in length by one yard in depth in one hour and a half, whereas in less hard coal and with more space for working the same amount of cutting can be performed in about one hour, allowing from 10 to 15 minutes for the erection of the machine. The latter can be placed in any desired position and the coal undercut at any angle.

To produce cuts of considerable length Mr. Lilienthal has arranged a machine, in which the cutting disk is not fixed to a movable frame, but where the slot already cut serves as a guide for the further progress of the wheel. Figs. 2 and 3, clearly illustrate this machine, which permits of a still larger amount of work being done by manual labor.

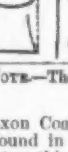
The machine of which we have been speaking has been employed not only in coal mines but also for working in the hard rock-salt with very satisfactory results. There are now a considerable number of these machines at work in the Wieliczka and Bochnia Salt Works, in Galicia, and we are in possession of some of the official returns showing the amount of work done by them in the ordinary course of working.



A miner working in rock-salt can cut from 7·5 to 8·6 square feet of surface in eight working hours; whereas two miners working with the machine have done, on an average taken over some weeks, 40 square feet in eight hours, or 20 square feet for each man, showing more than double the amount of work without any more exertion. The width of the cut being only $1\frac{3}{16}$ in., and only large pieces of rock-salt being used, there is a small saving in material in addition; this saving is also perceptible in coal mining, but may be of minor importance. Rock-salt is much harder to cut than coal, a given area of cut requiring from twice to three times as much labor in rock-salt as in coal. In ordinary coal one miner can cut about 21·5 square feet with his pick in eight working hours, and more than double this amount with a machine.

The construction of Mr. Lilienthal's coal-cutting machine was not commenced until the inventor had carried out an extensive series of experiments, showing the amount of resistance of coal to be cut under varying conditions, pressure of the overlying strata, etc. As we consider these figures of some interest and importance for the construction of coal-cutting machines, we give the results received from Mr. Lilienthal. The apparatus used for measuring the power necessary for cutting through coal is shown in Fig. 4. The hollow spindle shown is placed in a borehole previously made for this purpose; on this tube is mounted a sliding piece, the nut traveling inside the hollow tube, and the support extending through a slot in the tube. This bar serves as a rest for the cutter fixed to a lever, while a spring balance is attached to the other end of the lever, showing the amount of pull at any moment. The screw spindle serves to push forward the cutter to a certain extent, giving a cut of a certain thickness. These conditions fulfilled by this apparatus seemed to be as near those existing in an actual coal-cutting machine as it was possible to get. It was found that the coal could be cut much more easily near the surface than deeper into the cut, and the results given in the table below are only those obtained at depths approximately to those with which a coal-cutting machine has to deal. The table shows the results obtained with three cutters of different shapes, and for different thicknesses of cut. These experiments were made in very hard and uneven coal in the

Table showing Results of Experiments on the Power required to cut Coal.



Depth of Cut in Millimtrs.	1 mm.	2 mm.	3 mm.	4 mm.	5 mm.	6 mm.	7 mm.	8 mm.	9 mm.
Shape of Cutter.	45	90	130	170	220	260	350	450	600
	65	120	165	200	240	285	350	450	600
	60	110	150	180	210	250	310	400	540

Note.—The resistances are given in kilogrammes.

Royal Saxon Coal Mines at Döhlen, near Dresden; purer coal, as found in Zwickau, in Saxony, showed a resistance of about two-thirds that given in the table. Several other series of experiments, carried out in pure mild coal of Silesia, Austria, and Hungary, gave on an average resistances equal to half those noted in the table. It was further found that, particularly in brittle coal, a considerable reduction in the amount of resistance could be made by using pointed cutters of different shape following each other in the circumference of the wheel. The different sections used by Mr. Lilienthal in this machine are shown in Figs. 6 to 8, two of each of these sections being used. The cutters are of course made in two pieces, they being easily and cheaply made and sharpened. The good results obtained with these pointed cutters are due to the fact that the coal breaks away round the cutting edge, as shown in Fig. 9. With a pointed cutter a greater amount of cutting depth can be given without materially increasing the resistance.

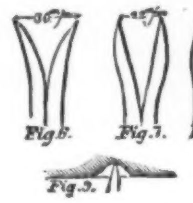


Fig. 6. Fig. 7. Fig. 8. Fig. 9.

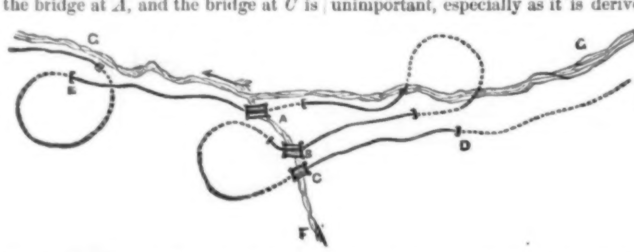
For coal of average hardness and quality a forward motion of the cutting wheel of about $\frac{1}{8}$ in. per revolution answers best. The resistance on each cutter in this case is about 100 lb., and one cutter would have to travel over 144 ft. to cut away 1 square foot of coal, being fed forward at the rate of one-twelfth of an inch each time; the work done for each square foot would consequently be represented by 144 ×100=14,400 foot-pounds. Two men working alternately on a crank exert in one hour about 250,000 foot-pounds, which would give about $17\frac{1}{2}$ square feet of coal cut per hour by two men; deducting the time necessary for fixing the machine, this theoretical deduction agrees very well with the actual results obtained.—*Engineering.*

THE ST. GOTHARD TUNNEL.

In a recent private letter written from Geneva to a gentleman of Philadelphia, Mr. Walton W. Evans, the eminent consulting engineer, speaks of the St. Gothard tunnel, now in course of construction, as follows:

. . . . "I went over the St. Gothard Railway with the engineer, as far as the big tunnel, to see the most difficult railway works ever attempted in the world; nearly one-third of the whole line is in tunnels. In some places the railway is put in tunnels to get it out of the reach of avalanches; in one case the engineer pointed out to me, as we were riding on the highway, 60 to 70 feet above the river, the place where an avalanche came down last summer, filling the whole valley, and coming up into the road where our carriage was. I will inclose to you a sketch of a piece of the location of this railway, taken from the map. Their fixed maximum gradient is 1 in 40; their fixed minimum radius of curvature is 1,000 meters. There are no side valleys to run up and back again to get distance, and as the valley in some places rises faster than the fixed gradient allows, the engineers are forced to tunnel into the sides of the mountains in entire circles (corkscrew circles) to get distance. The sketch I inclose shows three of these circular tunnels, about 8 kilos north of the big tunnel.

"The waved lines show water courses, *G G* being the River Reuss. The full lines show the location of the railway lines, and the dotted lines the tunnels. The points, *A*, *B*, and *C*, show bridges over a cascade. The bridge at *B* is about 500 feet above the bridge at *A*, and the bridge at *C* is



about 300 feet above that at *B*. The circles in the tunnels are 2,000 meters, or 6,562 feet diameter.

"On the south or Italian side of the big tunnel, are more difficult locations still. The roads here are beautiful; built and kept in order by the State. All their work is well done.

"The tunnels of this railway (even the big tunnel is solid granite, and wide enough for three tracks) are arched with granite, but little inferior to the face-work of the Astor House. You can imagine that none but the rich nations of Europe could, for a moment, think of building such a railway.

"I was run into the big tunnel for 2 kilos, on one of their air engines, to see a drilling machine I once explained to you. Baron Lauber tells me it is pressed against the rock with a pressure of 130 atmospheres, and that it walks into granite as if it were cheese."

In regard to the abundance of water-power in Switzerland, Mr. Evans says: "There is a tremendous water-power going to waste all over Switzerland; you can see in hundreds of places streams of water coming down nearly perpendicular for 1,000 or 2,000 feet. At the great tunnel of the St. Gothard Railway, the River Reuss crosses the very mouth of the tunnel, and gives the engineers a water-power fifty times greater than they can use for compressing air, making repairs, etc. etc."—*Journal Franklin Institute.*

RAILWAY NOTES.

After visiting the Red River Valley of the North, a correspondent of the *Tribune* writes as follows:

"On a summer's day in 1870 I rode amid the waving grass through this valley of the Red River. It was a solitude. No voice, save my own or the voices of my companions, disturbed the universal stillness. The virgin soil was as it had been for ages. There were not fifty people within 50 miles of the present line of the railroad. But now, wherever you look, you behold farmers driving their teams afield, preparing the ground for next spring's seeding. The men who put their money into the railroad have seen it sink out of sight, but through their impoverishment thousands are being made rich. What land-grabbers they were—those men who built this road from Lake Superior to the Missouri! They were maligned, decried, held up to scorn and contempt; but the time has come when a generous public should revise its opinions. They were public benefactors. What would these millions of acres be worth to-day if there were no railroads? Nothing. The land grabbers have lost their money, but through their loss 50,000 people have already obtained comfortable homes, and there are other millions of acres just as fertile awaiting the coming of the multitude that in future years will people this Northwest beyond the Northwest."

The Northern Pacific Railroad has been receiving proposals for grading, bridging, and completing, ready for the track superstructure, that portion of its line extending from the west bank of the Missouri River, opposite the present terminus of its railroad at Bismarck, to the Yellowstone River, at or near the mouth of Glendive Creek, a distance of about 200 miles. The first, or easterly section of 25 miles, is to be completed by July 15, 1879; the second section, by August 1, 1879; the third section, by September 1, 1879; the fourth section, by October 1, 1879; and the other sections before January 1, 1880.

The Southern Pacific Railroad Company, after waiting at Yuma, Arizona, for more than a year, have renewed their work on that part of the line. Material had been concentrated for the construction of 200 miles of the road along the Gila River, and 1,500 men were in the field during the fall. Passenger trains were expected to run to Gila City by the middle of December.

The earnings of 29 of the principal railways of the country for the nine months ending September 30 make an aggregate of \$92,014,088, as against only \$87,835,482 earned by the same roads in the corresponding period last year, showing a gain of nearly 5 per cent. This is encouraging to stockholders, and is a straw indicating the return of prosperity.

Formerly, all American locomotives were jacketed with Russia sheet iron. Now, America makes its own planished iron, and the importation of the foreign article has fallen from 25,000 packages to 1,000 packages per annum. It is said that it costs just half as much to build a locomotive now as it did five years ago.

According to the various official reports, in 1871 the gross number of sleepers in use on the railways of the world was 250,000,000. Taking the life of a sleeper at an average of some eight years, and allowing for the large increase of mileage since that date, it would appear that above 45,000,000 of sleepers must be the annual requirements; or, making a deduction of about 5,000,000, on account of many railroads being laid with cast and wrought iron sleepers, the yearly destruction now going on may be fairly taken at 40,000,000. These contain, on an average, about two and one-half cubic feet of timber in each sleeper, or about 100,000,000 of cubic feet, and, even at the most moderate estimate of their value, an enormous sum is necessarily expended annually on this one item in railroad construction in the various countries.

Iron sleepers, it is stated, have proved, so far as tested, cheaper than wooden ones, both in India and in England, and it is believed that the time cannot be far distant when they will be generally preferred, on the score of economy, in all parts of the world; some minor inconveniences attending their use hitherto will doubtless be obviated by coming improvements.

Colonel Crosby, U. S. Consul at Florence, in a recent report to the Department of State on the subject of the demand and supply of steel rails in Italy, says:

"In view of the fact that so much capital in the United States is invested in the manufacture of steel rails and other railway materials, and our principal roads are replacing the iron with steel rails, the following information may not be unimportant, especially as it is derived from a very careful inquiry into the subject, and from the best railway authorities and agent of European manufacturers in Italy.

"The three most important railway companies in Italy—Ferrovie Alta Italia, Strade Ferrate Romane, Strade Ferrate Meridionali—have decided within the past five years to adopt steel rails and mostly steel fish plates.

"A series of trials have been made to ascertain the form which renders the best result in fishing rails, and it has generally been considered that the angle fish plates, supporting suspended joints, preserve the line in the most solid state.

"The Meridionali Railway has been adopting, with very good results, rails 12 meters long, which reduce the cost of fish plates, bolts, etc. Of course the angle fish plates weighing about 9 kilos (19,845 lbs.) are heavier than the ordinary plain ones, but they certainly give greater sustenance to the joints and helps to serve a smoother track. The results in Italy are very encouraging. The prices for steel rails have been lately exceedingly low, averaging little more than £6 sterling per ton, delivered free on board at Italian ports.

"Certain large Sheffield manufacturers of steel rails, such as Brown, Bayley & Dixon and others, who have heretofore furnished a large amount of steel rails for Italy, have not quoted such a low figure, preferring to keep up their old standard of quality and price, but it is the German and Belgian firms that have quoted the extreme prices, being so hungry for orders that, as they themselves aver, 'they tender below cost price to secure work for their mills in preference to closing them.' It is the opinion of those best able to judge that the means of production in the steel trade have been so much augmented that the requirements in Europe and in other countries outside of the United States will be for some years much too small to give anything like full employment to the bulk of the works. A fair estimate might be easily obtained of the quantity of steel material required in Europe during the next few years by acquiring from each country an approximation of its consumption. Italy, for example, will probably purchase some 40,000 tons of steel rails per annum during the next five years; France, Germany, Belgium, and England can produce far more than they are actually using. (The French railways only bought

last year from their native manufacturers about 137,000 tons of steel rails.) So that a moment's consideration will show the means of production in Europe is far beyond the presumable demand. It is consequently to be deduced that the depression which has existed in the metallurgical trade during the last three years will not be removed for some time to come.

"The fuel for locomotives used here is for the most part the manufactured briquettes, composed of hard and soft coal and a sufficient proportion of tar. The combustion of this fuel requires, of course, careful and constant attention; and as the engine drivers unfortunately do not devote themselves to it, a greater amount of smoke attends traveling in Italy than elsewhere when these briquettes are not used, not to mention also the loss in proportion of caloric power. On some of the freight engines lignite is alone employed."

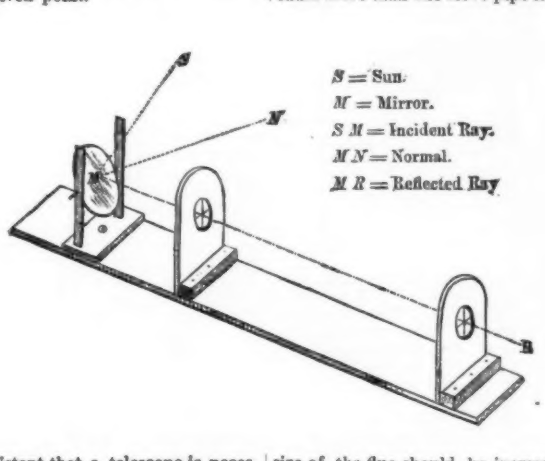
GEODETIC SURVEYS.

By L. M. HAUPT, Professor of Civil Engineering, Towne Scientific School.

THE heliotrope is used to reflect the sun's rays to distant points, and thus facilitate the operation of reading angles, either horizontal or vertical, on lines of from 15 to 100 miles in length. The name is derived from *helios*, the sun, and *trope*, turning—hence the instrument is one which turns or deflects the rays in any required direction. It differs from the heliostat in not being automatic.

Its construction is so simple that it may be made by any schoolboy with a penknife. Two opaque screens are placed about 18 inches apart upon a strip of wood forming a base and screwed or nailed fast. A hole about one inch in diameter should be cut through each screen, the one in the rear being a little larger than the other, and across each there should be drawn two fine wires or threads so as to intersect each other.

About six inches in rear of the screens there should be placed a small mirror, 3 inches in diameter will be sufficient, so mounted as to have the two motions horizontal (or in azimuth) and vertical (or in altitude). The crude instrument is then ready for operation. To throw the ray upon any given object visible to the unaided eye, turn the mirror down out of the way or remove it altogether, and sight across the wires, moving the base until the line joining the intersection of the cross wires passes through the object. Then replace the mirror carefully so as not to disturb the line of sight, and turn it in either or both directions until the shadow of the edge of the hole in the first screen is concentric with that in the second. The reflected ray will then be visible to an observer at a given point.



When the observer is so distant that a telescope is necessary to determine the direction to him, the instrument is modified by attaching the rings and mirror to the telescope, care being taken that the axis of the rings is parallel to that of the instrument. Should the sun be in the plane of the mirror or back of it so that no reflection can be obtained, an auxiliary mirror must be used and placed in such a position as to reflect the ray upon the primary mirror, which, by a second reflection, sends it through the rings.

Although so simple and inexpensive, this little instrument serves to increase greatly the economy and accuracy of reading angles to very distant objects. The rays reflected from it are plainly visible to the naked eye at from 30 to 50 miles, and with telescopes these "day stars" have been seen at a distance of nearly 100 miles across Lake Superior when no trace of land was visible.

It needs no second thought to perceive that they may be used as were the semaphores of Claude Chappe introduced in 1794 as the first efficient *telegraph*, but with greater effect. By adopting any convenient code of long and short flashes, made by obscuring the ray, messages may be sent from point to point. In one instance a vessel was saved by signaling to a party at Marquette, Lake Superior, that she had grounded on some rocks near the station "Vulcan" near Keweenaw Point.

The Morse code is as convenient as any other, but for simplicity a conventional code expressing certain sentences by a few flashes is found to answer the ordinary requirements of field work.—*Journal Franklin Institute.*

HINTS ON BUILDING CHIMNEYS.*

1. A BROAD, deep, and substantial foundation is necessary,—one that will not settle or be disturbed by frost. If the chimney is built in or rests upon the wall of the basement or cellar, the wall at that point should be sufficiently broad.

2. The chimney should be perpendicular, straight and smooth, without angles, corners, jogs, or contraction, and at no point in contact with wood; with a space of an inch or more where it passes joists, rafters, or timbers, or through floors, ceilings, or roofs, and at least four inches between the back of the chimney and the end or side of the building. Joists should not be masoned in or rest upon or against the chimney wall, but a header well removed from the chimney used for their support. An additional reason why chimneys should be built very strong and entirely free from contact with any wood in the frame buildings of our Western country is that they are so often what is known as "balloon frames," so lightly put up that they are always liable to be shaken by our heavy winds so as to cause cracks in chimneys otherwise constructed.

3. The walls of the chimney, when built of brick, should be six, eight, or more inches thick. A chimney with six-inch walls, the inside course set on the edge and bound with brick laid transversely every four or five courses, is nearly as safe as an eight-inch. Where an eight-inch wall is laid it is perhaps better to leave a space of about an inch between the two courses of brick, occasionally binding by laying a brick transversely. A wall of this kind will not heat so as to endanger wood even in pretty close proximity. The chimney should be put up at a time when free access can be had by the masons to every part of its outside, before joists and other timbers have been placed in the way and before the roof has been put on. Four-inch walls are unsafe at the best, and particularly so if there is any truth in the theory that brick exposed to hot air or steam will in time show a larger amount of heat than is at any time in the heated air or steam passing by or in contact with it; that is, if brick will accumulate heat as we know some metals and minerals do. We know of some facts that seem to support this theory. It is true, many queer fires from furnaces and chimneys will perhaps be more satisfactorily accounted for.

4. There should be openings at the bottom of the chimney and of each separate flue for the removal of soot. These openings should be closed with a heavy iron box or scoop-shaped stopper. If left open the draught will be affected, and besides, there will be danger of fire falling on the floor. These soot boxes, or scoops, unless made of heavy iron, are liable to rust out, owing to the damp soot and pyroligneous acid.

5. The chimney should be smoothly plastered with a mortar composed of one part fresh cow dung and three parts ordinary mortar. The mixture should be made from time to time, as needed, and applied before it has time to set and become hard. A chimney so plastered will soon present a hard surface nearly as smooth as glass. Soot will not accumulate on the sides of the flue, and the draught will be quite perfect, other things being observed. The draught will be still further improved if the area of the flue is increased one inch every ten feet from the bottom to the top.

6. The flue for an ordinary dwelling fire-place or stove-pipe should have an area of at least 128 square inches for a wood or soft coal fire, and not less than 96 square inches for a grate or stove burning hard coal. Where large wood or soft coal fires are required, the area should be 192 square inches. Each fire-place or stove-pipe should have a separate flue, otherwise you cannot rely upon the draught. If for any cause more than one stove pipe is to enter the same flue, the size of the flue should be increased one fourth for each additional pipe.

7. The hearth should rest upon a brick or stone arch. Timber and board foundations are always concealed incendiaries; iron, because of its power to conduct heat, is also unsafe.

8. The throat of the fire-place should be well contracted and pitched forward, so as to be directly over the fire. This will insure a draught, owing to the fact that the part of the atmosphere not passing through the fire, but entering the flue, will come in more direct contact with the heat, and thereby be more highly rarefied. The construction of the chimney being right, the draught is produced by the air being rarefied in passing through and over the fire. This heated and lighter air ascends the flue, while the denser air in the room rushes forward to supply the partial vacuum. [A common but inexact way of putting the case.—EDS. AM. ARCHT.] Sometimes the draught is imperfect, becomes a sufficient supply of air is not admitted to the room; and in other cases, owing to an open pipe or soot-box hole. All openings should be closed with brick and mortar or closely fitted metal stoppers. The modern practice of pasting a piece of paper over an opening should not be permitted.

9. The walls of the chimney, particularly on the back side, where it is concealed from inspection, and at points where the chimney passes near wood, should be most carefully laid, pointed and plastered on the outside. Fires from defective flues where there is no crack usually reveal the fact, if the chimney is left standing, that the wall on the back side, at points passing near timbers through floors on the roof, has not been well pointed and plastered on the outside. Good work has been done only at points or places exposed to the eye, and where there was no danger from fire.

10. The practice, in many cases, of building a water-shed by projecting the brick just above the roof, should not obtain, nor should the chimney at this point be enlarged for any purpose. The projecting bricks in a majority of cases rest upon the rafters or roof boards; and if at any time the chimney below should settle, there will be a crack and by and by a fire. Chimneys thus enlarged above the roof, presenting a massive and substantial appearance, fail to suggest the truth as to the small and cheaply constructed flue below. A word in regard to chimney sweeps and stated periods for cleaning flues. In places where ordinances have been passed and enforced on this subject, and sweeps licensed, fires caused by the burning out of chimneys or from defective flues have been of rare occurrence. Perhaps if in our respective fields we were to aid in having ordinances touching this matter passed we would prove ourselves public benefactors, and at the same time promote the interests of insurance companies.

* From a paper read at the Underwriters' Convention, at Chicago, by Mr. Daniel Morse, of the Home Insurance Company of New York.

OLIVER EVANS' MODEL MILL OF 1783.

IT was Oliver Evans who gave the first impetus to improvement in the mills of this country, and to his inventions we are indebted for the fact that in Germany, American milling was called "scientific milling." His "model mill," therefore, is worthy of a place of honor in our columns, for although the mill never had an existence save on paper, the improvements it illustrates find a place in every mill in the land.

It is not our intention to give at this time an account of this extraordinary man; we shall defer our tribute of gratitude until another time. Evans was born in 1755, at Newport, Del., and the improvements which he made in flour mills were completed about the year 1783. These improvements, or rather inventions, were five in number, namely, the elevator, conveyor, the hopper-boy, the drill, and the descender. The engraving on next page shows the plan of a three-run mill with these improvements. Take away the elevators, conveyors, and hopper-boy, and you see that little is left of the mill besides the burrs, worthy the name of machinery; but these subtractions are necessary in order to picture faithfully the machinery and interior even of the best mills, a hundred years ago. Elevators and conveyors are deemed very necessary things now, but it took Oliver Evans a whole lifetime to convince millers of the fact, even though they had the testimony of their own eyes as proof of his assertions. But let us return to the model mill, whose operations we allow Mr. Evans to describe in his own words. The strong claim that he makes is that the mill is automatic, a wonderful thing in those days.

"The grain is emptied from the wagon into the spout, 1, which is set in the wall, and conveys it into the scale, 2, that is made to hold 10, 20, 30, or 60 bushels, at pleasure.

"When the wheat is weighed, draw the gate at the bottom of the scale, and let it run into the garner, 3; at the bottom of which there is a gate to let into the elevator, 4 to 5, which raises it to 5; the crane spout is to be turned over the great store garner, 6, which communicates from floor to floor, to garner, 7, over the stones, 8, which may be intended for shelling or rubbing the wheat, before it is ground, to take off all dust that sticks to the grain, or to break smut, fly-eaten grain, lumps of dust, etc. As it is rubbed, it runs into 3 again; in its passage it goes through a current of wind, blowing into the tight room, 9, having only the spout, *a*, through the lower floor for the wind to escape; all the chaff will settle in the room, but most of the dust will pass out with the wind at *a*. The wheat again runs into the elevator, at 4, and the crane spout, at 5, is turned over the screen hoppers, 10 or 11, and the grain lodged there, out of which it runs into the rolling screen, 12, and descends through the current of wind made by the fan, 13; the clean heavy grain descends, by 14, into conveyor, 15-16, which conveys it into all the garners over the stones, 7-17-18, and these regularly supply the stones, 8-19-20, keeping always an equal quantity in the hoppers, which will cause them to feed regularly; as it is ground, the meal falls to the conveyor, 21-22, which collects it to the meal elevator at 23, and it is raised to 24, whence it gently runs down the spout to the hopper-boy at 25, which spreads and cools it sufficiently, and gathers it into the bolting hoppers, both of which it attends regularly; as it passes through the superfine cloths, 26, the superfine flour falls into the packing chest, 28, which is on the second floor. If the flour is to be loaded on wagons, it should be packed on this floor, that it may conveniently be rolled into them; but if the flour is to be put on board a vessel, it will be more convenient to pack on the lower floor, out of chest, 29, and thence roll it into the vessel at 30. The shorts and bran should be kept on the second floor, that they may be conveyed by spouts into the vessel's hold, to save labor.

"The rubbings which fall from the tail of the first reel, 26, are guided into the head of the second reel, 27, which is in the same chest, near the floor, to save both room and machinery. On the head of this reel is six or seven feet of fine cloth, for tail flour; and next to it the middling stuff, etc.

"The tail flour which falls from the tail of the first reel, 26, and the head of the second reel, 27, and requires to be bolted over again, is guided by a spout, as shown by dotted line, 21-22, into the conveyor, 22-23, to be hoisted again with the ground meal; a little bran may be let in with it, to keep the cloth open in warm weather; but if there be not a fall sufficient for the tail flour to run into the lower conveyor, there may be one set to convey it into the elevator, as 31-32. There is a little regulating board, turning on the joint *x*, under the tail of the first reels to guide more or less with the tail flour.

"The middlings, as they fall, are conveyed into the eye of either pair of mill stones by the conveyor, 31-32, and ground over with the wheat; this is the best way of grinding them, because the grain keeps them from being killed: there is no time lost in doing it, and they are regularly mixed with the flour. There is a sliding board set slanting, to guide the middlings over the conveyor, that the miller may take only such part for grinding over as he shall judge fit; a little regulating board stand between the tail flour and middlings, to guide more or less into the stones or elevator.

"The light grains of wheat, screenings, etc., after being blown by the fan, 13, fall into the screenings garner, 32; the chaff is driven farther on, and settles in the chaff room, 33; the greater part of the dust will be carried out with the wind through the wall.

"The bolting reels may all be set in a line connected by jointed gudgeons, supported by bearers. The meal, as it leaves the tail of one reel, may be introduced into the head of the other, by an elevator bucket, fixed on the head of the reel open at the side next the center, so that it will dip up the meal, and, as it passes over the center, drop it in. This improvement was made by Mr. Jonathan Ellicott; and by it, in many cases, many wheels and shafts, and much room may be saved

"In order to clean the screenings, draw the little gate, 34, and let them into the elevator at 4, to be elevated into garner, 10; then draw gate 10, and shut 11 and 34, and let them pass through the rolling screen, 12, and fan, 13; and as they fall at 14, guide them down a spout (shown by dotted lines) into the elevator at 4, and elevate them into the screen-hopper, 11; then draw gate 11, shut 10, and let them take the same course over again, and return into the garner, 10, etc., as often as necessary; when cleaned, guide them into the stones to be ground. The screenings of the screenings are now in garner, 32, which may be cleaned as before, and an inferior quality of meal made out of them. By these means the wheat may be effectually separated from the seed of weeds, etc., and these saved for food for cattle.

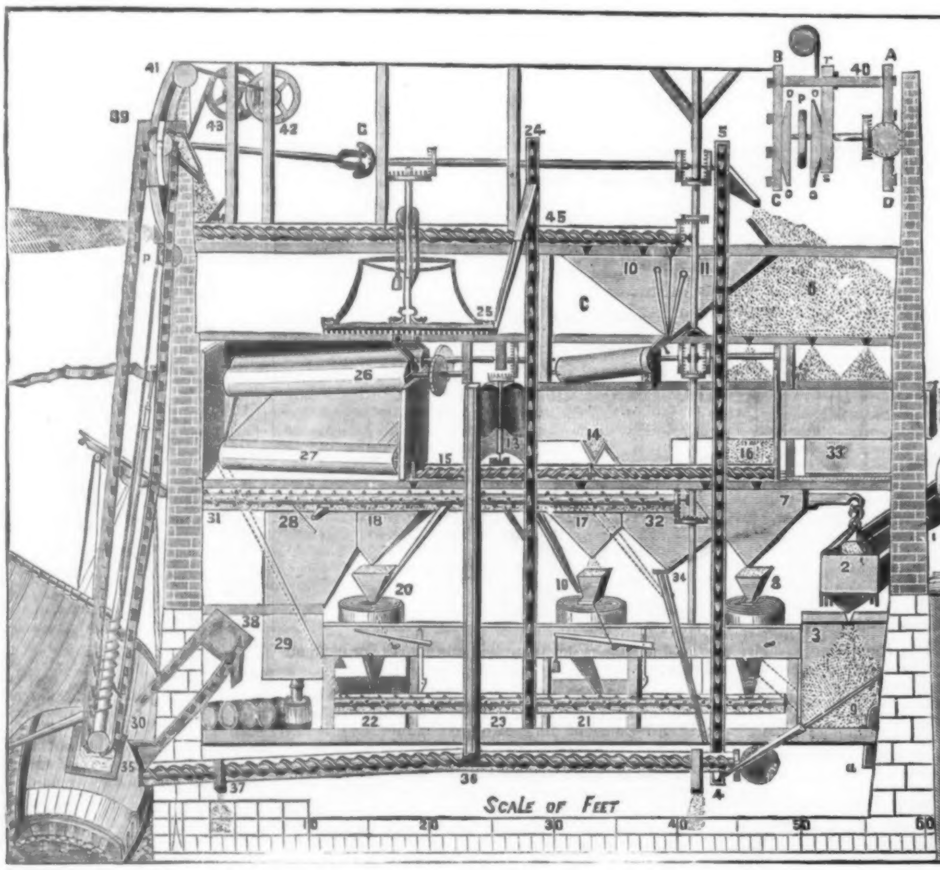
"This completes the whole process from the wagon to the

wagon again, without manual labor, except in packing the flour and rolling it in."

Now all this is the very alphabet of milling to-day, and some of the details are so antique that they would not be recognized by our younger generation of millers as forming a part of the operations of a mill. Still, it was all very new and strange in Evans' time, and he spent a fortune in trying to make millers believe that it was also useful. One can hardly believe the ridiculous stories which are told of the prejudice millers entertained against the innovations which Evans had made upon "the good old plan" which their ancestors had followed out in milling ever since the time of the Conquest. Oliver Evans' brothers were millers, and it was in their mill that he first placed his improvements. They saved over half in the cost of attendance and manufactured better flour, making 28 pounds more per barrel than they had done under the old plan, for Evans made other changes in the stone and bolts. They fully appreciated the gain, and assisted Oliver in traveling through Delaware, Maryland, Virginia, and Pennsylvania in order to introduce these improvements. But although he offered to put them in gratis in the first mill in each county that would adopt them, no miller could be found who would make the venture.

The Brandywine millers were the leaders in the milling industry at that day, and their prejudice was even more reprehensible than that of other millers, since they could inspect Mr. Evans' mill, and see exactly what it was doing. They held a consultation one day to see upon what terms Evans would put his improvements in their mills, and this is what their deputy said: "Oliver, we have had a meeting, and agreed that if thee would furnish all the materials and thy own boarding, and come thyself to set up the machinery, in one of our mills, thee may come and try, and if it answers a valuable purpose we will pay thy bill; (!) but if it does not answer, thee must take it all out again, and leave the mill just as thee finds it at thy own expense." This proposition would probably have been accepted, though it was hardly a liberal one, if Evans had not known exactly the amount of prejudice he had to contend against. These same Brandywine millers once visited Evans' mill, when he was out in the field making hay. When they entered the mill they found all the operations of cleaning, grinding, and bolting going on without the intervention of a human hand; whereas, in their own mills, the carrying all had to be done by manual labor. Evans came in from the field and showed them through his mill, pointing out the advantages of this and that contrivance. These enlightened millers went home and reported that he had a lot of "rattle traps" in his mill. After awhile Evans made a two-run mill for a Brandywine miller who had the requisite amount of sense to see there was money in the improvements. It was a grand success, all the operations except packing being done automatically, and the flour produced being much better than was made in that locality; but even then, one of the neighboring millers who was witnessing the wonders of the elevator, conveyor, and hopper-boy, exclaimed: "It will not do; it is impossible that it should do." Evans lived to see most of these men adopt his improvements, although he was obliged to sue some doughheads to make them respect his patent. In one mill alone, near Baltimore, the annual saving by adopting his improvements amounted to nearly forty thousand dollars, and the salvage was in the same ratio in other mills.

Oliver Evans never saw a smutter, a purifier, or a branduster, not to mention the innumerable other devices now deemed necessary for successful milling; but notwithstanding this, he is entitled to the first place in the history of American milling. It was not only by his inventions that the industry was improved, but also by the practical views he brought to bear upon the machinery of the flour mill. In his works may be found hints which were the germs of subsequent inventions, and besides all this, he was an excellent and practical millwright. His name is entitled to be held in everlasting and grateful remembrance by the millers and millwrights of America; for it was his labors that paved the way for all subsequent progress. It is the first step that is difficult, says a Spanish proverb, and Oliver Evans took that step in milling. Mankind have not given him the place on the roll of fame which his other inventions entitle him to have; but let millers at least hold him and his quaint model mill in grateful reverence.—*American Miller.*



OLIVER EVANS' MODEL MILL OF 1783.

ALUM IN BAKING POWDERS.

To the Editor of the Scientific American:

This is an age of startling scientific announcement: of newly discovered facts and principles, and of new views of old ones, unsettling old convictions, and substituting therefor conclusions modified, and often reversed. The thoughtful man may hold his decision in abeyance until his reason is satisfied, but experience has taught him that scarcely anything is too strange to be true in this age.

These thoughts are suggested in connection with the now widespread use of alum, a substance that has been loudly and thoughtlessly denounced as a poison in baking powders. Few persons, outside of manufacturers themselves, are aware of the enormous consumption of baking powders in the United States. Fewer yet are aware that there are probably 500 lbs. sold, in which alum is an ingredient, to one pound made of cream tartar and soda only. We think this statement might be readily substantiated. We doubt not that all the large alum manufacturers could, if they would, name purchasers among baking powder manufacturers, who buy amounts exceeding one hundred tons yearly. These are startling statements to those who have held the commonly received opinion of the poisonous character of alum. The mere fact of its extensive use is sufficient to make it an imperative public necessity, that the question of its healthfulness or otherwise be fully discussed and finally settled, and that, too without appeal to preconceived prejudice or to the well-known ignorance of the general public on chemical and physiological questions. This discussion should be taken up and settled from a scientific standpoint purely, and individual interests ignored, in arriving at the truth regarding so important a matter. We are pleased that you have opened your columns for the ventilation of this subject.

We agree with Mr. Pemberton in his reply to Prof. Mott's article, that the latter, in his attack on manufacturers of alum baking powders, has ignored the real question. The point is not whether alum in bread is injurious, but whether alum in baking powder does harm. There has existed a deeply rooted prejudice in the minds of chemists, physicians, and through them, the public, which has settled upon a mixture of cream tartar and soda as a finality—as perfection, both in healthfulness and efficiency, as a baking powder.

This prejudice has been nursed and fostered by interested parties who loudly proclaim the virgin purity of their compounds, and the unutterable wickedness of all who could or would presume to say that anything better, or even as good, could be found. Now the facts are these: There is no standard law or enactment that confines the substances to be used in baking powders to cream tartar and soda. The ingredients of a baking powder are selected and combined for the purpose of eliminating a gas or gases, the escape of which in baking gives the bread its porous structure or "lightness." Any combination that will furnish gases for this purpose, and not leave a deleterious substance in the bread, may be used, and is, in the common acceptation of the time, a baking powder. Hence all the talk about adulteration with alum, because it is used as the acid substance, wholly or in part, comes from either ignorant, thoughtless, or interested persons. We might with equal propriety speak of a baking powder adulterated with cream tartar. The addition of flour, starch, terra alba, plaster of Paris, or any substance which does not take part in the chemical reaction, which eliminates the gas, is the only one that could or should be spoken of as an adulteration. The whole question is really one of the comparative merits of alum and cream tartar used in baking powders. To reach a conclusion we must settle the following points:

1. Which accomplishes the purpose of rendering the bread light most perfectly?

2. What substances are left in the bread after baking, and their amounts?

3. What are the effects of these residual substances on health?

For the purpose of presenting the first two points clearly, we invite attention to and examination of the following equations, representing, symbolically, the reaction in two typical baking powders, one made with cream tartar and soda, and the other with anhydrous alum and soda. As is generally known, ammonia alum is generally used, and in the anhydrous state, in order that the gases may be given off slowly, the reaction only taking place as the alum takes up again the water that it has lost in calcination.

The figures represent the molecular weights of the substances reacting, supposing them chemically pure, and the amounts produced of gases and residual salts:

CREAM TARTAR POWDER.

Cream Tartar.		Bicarb. Soda.		Rochelle Salts.		Water.		Carbonic Acid Gas.
$KHC_4H_4O_6$	+	$NaHCO_3$	=	$KNaC_4H_4O_6$	+	H_2O	+	CO_2
188		84		210		18		44

ALUM POWDER.

Ammonia Alum.		Bicarb. Soda.		Sulphate of Soda.		Hydrate Alumina.		Water.		Ammonia Gas		Carb. Acid Gas.
$Al_23SO_4(NH_4)_2SO_4$	+	$8NaHCO_3$	=	$4Na_2SO_4$	+	Al_26HO	+	$2H_2O$	+	$2NH_3$	+	$8CO_2$
483		672		576		157		36		34		352

From above, it may be seen that the relation between the amount of materials used, and the weight of gases and residual salts produced, are as follows:

CREAM TARTAR POWDER.

Material used	272	parts.
Gas produced, 16½ per ct. of above, or...	44	"
Rochelle salts left in bread, 77 per ct., or	210	"
Balance water.		

ALUM POWDER.

Material used..............................	1,155	parts.
Gases produced, 33⅓ per ct. of above,		
viz. { Ammonia gas	34	"
viz. { Carbonic acid gas................	352	"
Glauber salts, } left in bread { 576 }	733	"
Hydrate of alumina, { 63 per cent. } 157 }		
Balance water.		

Or in other words, using the same weight of each, from the alum powder double the amount of gases are obtained, and 14 per cent. less residual salts are left in the bread than when the cream tartar powder is used. Add to this the fact that, with the alum powder, even an indifferent cook can make light bread, easily penetrated by the gastric juices, and the weight of chemical testimony is in favor of the alum powder on points one and two.

The third point is as to the relative healthfulness of the residual salts from the two powders.

All modern authorities on therapeutics class both Rochelle and Glauber salts as simple saline cathartics or laxatives, according to dose. They both produce liquid stools. Whether this results from the abstraction of water from the circulation, by increasing secretion from the coats of the stomach and intestines, or by retaining the water passing into them with food and drink, is not well settled. The latter view rather predominates. Neither are ever spoken of as harmful. Hydrate of alumina is a white gelatinous, tasteless and inert substance, which after being heated in the baking of bread

will not dissolve in the acids of the stomach, or would be harmless if it did, as it would be immediately reprecipitated when the food passed on into contact with the alkaline juices of the intestines. As will be seen the amount of hydrate of alumina and Glauber salts added together do not equal that of the Rochelle salts left in the bread when cream tartar is used, being 14 per cent. less.

It might be claimed that an excess of alum might be used, and thus do damage. The best reply to this is that the manufacturer will not do what is contrary to his self interest, and the use of more alum than would be necessary to decompose the soda would most certainly be a useless waste. Alum is frequently given in considerable doses to small children without injury, and it is by no means certain that it would do any more harm than a similar excess of cream tartar, as much might be written, and authorities cited, to prove that even this salt is hurtful where improperly used.

To recapitulate, we think it may be fairly claimed for alum that it possesses, in addition to its less cost, these advantages over cream tartar when used as the acid salt in a baking powder:

1. More certain results in baking and quality of bread, on account of slow elimination of gases.
2. More gas from a given weight.
3. Less residual salts left in the bread. And, at least, equal healthfulness.

We formerly held the common opinion on this subject, but have arrived at these conclusions after careful study, and we believe that any physician, chemist, or other intelligent person who can lay aside his preconceived prejudices and examine the above statements with candor, will agree with us.

The alum powder, we believe, will be the baking powder of the future, unless some other substance is discovered that is superior.

We know that it is, practically, the baking powder of the present, though the community at large do not know it. They should know it, however, and if "we be all dead men," as we certainly should be if the enemies of this substance are to be believed, we are a well preserved set of mummies, and alum should have the credit as the antiseptic. A. M., M.D.

CERESIN.

A material known as *ceresin* has lately become an article of considerable export to this country, ostensibly as a substitute for beeswax; but, in reality, it is said to be used as an adulterant of the latter article. It first became familiarly known in this country at the time of the Centennial Exhibition, where it was exhibited among other products in the Austrian section. This material is a mineral or fossil wax, the purified product of a substance called ozocerite, which is found at present chiefly near the extensive coal beds of lower Germany and Austria. A great importance is attached to the product in Europe, as may be conceived when it is stated that a single factory in Austria produces annually upward of one million pounds of it. Since the time of the Centennial Exhibition its use seems to have largely increased in this country, and quite recently a mine of it has been opened and operated to a small extent in the West. It is thought that the substance can be also obtained in other parts of the United States, and that its production might become an important industry. In regard to the merits of ceresin, diverse opinions are expressed; dealers in beeswax assert that it is capable of fulfilling none of the requirements of beeswax in any respect, but, being much cheaper, is merely used to adulterate the latter. The advocates of the article, however, assert that it can be advantageously employed as a substitute for the more costly beeswax in the manufacture of candles, pomades, wax flowers, and for polishing, cloth finishing, and the laundry; and also that for pharmaceutical purposes it proves an excellent substitute for beeswax, inasmuch as it not only retards but entirely prevents rancidity in ointments, and its melting point is higher than that of the beeswax. Ceresin has also been used successfully in making the comb foundations in boxes in which bees form their combs and deposit their honey, and as the bees take kindly to it, they are thereby induced to build their combs on ceresin foundations, and so actually pack their honey in boxes ready for transportation and trade purposes. It is said that the miners of Pennsylvania and other States have heretofore been accustomed to use a substance, very similar to that from which ceresin is prepared, for wrapping around cotton wicks, and thus forming a rude sort of candle.

Bronze on Feathers.—Fashion has introduced gilded and silvered feathers. It is chiefly goose feathers and wings of pigeons, which appear covered with gold and silver. The process is very simple. The feather is dipped in bronze powder and rubbed with a piece of wash-leather. In course of wearing, however, the bronze is very easily detached. To prevent this, the feather, before being dipped in the bronze powder, is taken through gum water, pressed nearly dry between cloths, and in its slightly adhesive state is treated with bronze powder.

Partially bronzed feathers and wings are produced by covering those parts which are to remain plain with pasteboard, and the bronze powder is rubbed upon the rest with a feather.—*Farber-Zeitung.*

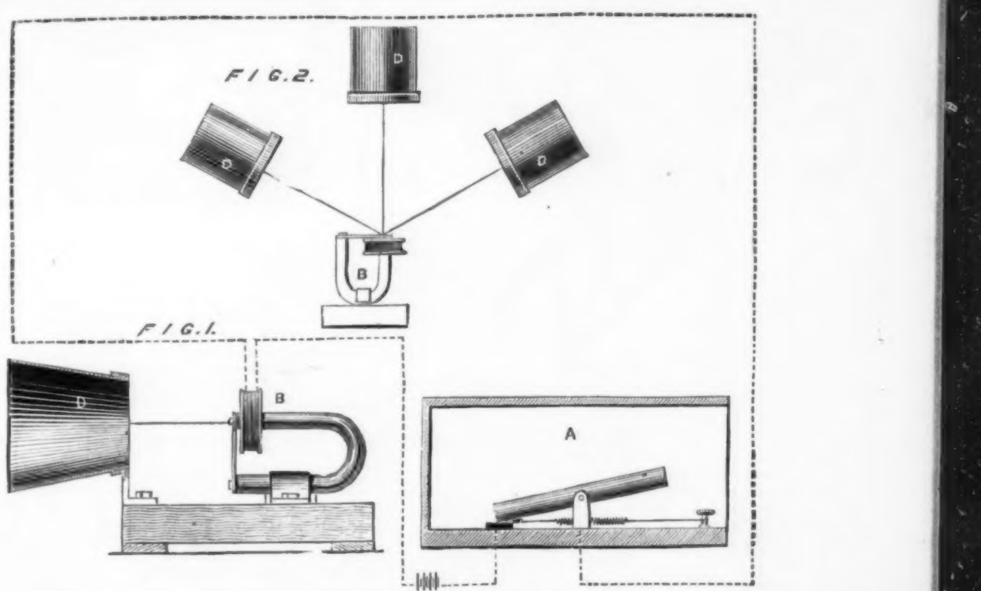
[Of course varied effects may be produced by dyeing the feathers with aniline-colors, etc., prior to the application of the bronze.]

PREECE'S IMPROVEMENTS IN TELEPHONES.

The following description of Mr. Preece's improvements in telephones, says the *English Mechanic*, will be read with interest in this country and America, for reasons well known to our readers. The invention relates to improvements in telephones generally, but especially to those employed for the reproduction of musical sounds. An electric telephone is, as is well known, an instrument which causes matter at a distance to vibrate in unison with other matter vibrating at home. The latter, by its motion or vibration, is made to form or to vary electric currents in such a way as to act electro-magnetically on the former, and reproduce in it similar sonorous vibrations. In Reiss's, Gray's, Varley's, Bell's, and other known forms of telephone, these sonorous vibrations are reproduced directly by the action of the electricity, and are re-enforced by simple sounding boards or resonators. According to this invention the vibrations produced in the receiving instrument are transferred from their source to fixed or stretched membranes or disks in such a way as to increase the quantity of air thrown into sonorous vibration. Any approved kind of transmitter is applicable to this form of telephone, but the patentee proposes in general to use the instrument known as Hughes' microphone.

The receiving instrument consists of a polarized relay, whose armature, vibrating in unison with the original source of sound, will, by its connection through a wire with a drumhead similar to that of the toy telephone, reproduce the transmitted sounds, whether articulate or otherwise.

Fig. 1 shows partly in sectional elevation the arrangement of apparatus employed for transmitting musical and other sounds according to this invention. A represents the ordinary Hughes microphone, connected by means of insulated wires with the reel on the polarized relay, B, a battery being placed in the circuit. The relay consists of a horseshoe magnet, to one pole of which one end of an elastic steel armature is attached by a clamping screw, the other end being free to vibrate in front of the other pole of the magnet. Around this pole is the coil of insulated wire, which forms part of the electric circuit. When a sound is delivered into the microphone, the pivoted tube or its equivalent, which forms the electric connection between the wires through the carbon block, will be thrown into vibration, and the even flow of the electric current being thereby disturbed, the elastic armature of the relay will be caused to vibrate in unison, as is well understood, thereby producing at a distance the sound received into the microphone, A. In order to increase the volume of the sound produced in the relay, the vibrating armature is connected with a sound amplifier, D, by means of a wire. This sound amplifier may consist of a piece of animal or vegetable parchment stretched over a conical tube, and secured in place by a hoop, similar to a drumhead; or it may consist of a disk or plate of ebonite or



PREECE'S IMPROVEMENTS IN TELEPHONES.

of thin sheet iron, secured in a frame or open case. The wire will be attached to the center of the disk plate or parchment in any convenient manner that will insure the transmission through the wire of the vibrations of the armature to the disk plate or membrane. It will now be understood that any sounds delivered into the transmitting instrument, A, will be reproduced in the receiving instrument, B, and the volume of this received sound will be increased by the sound amplifier, D; the increase of the volume of sound will vary according to the size of the disk or membrane put into vibration.

Mr. Preece finds by experience that in transmitting sounds to one person a disk of about 2 ins. in diameter will produce a good result, but he proposes to increase the area of vibration relatively to the increased volume of sound required to be produced to suit various sizes of auditorium. He also proposes to connect with a vibrating armature two or more sound amplifiers of the proportion above indicated, so that the sounds transmitted from the Hughes or other instrument may be heard simultaneously by two or more persons. Fig. 2 illustrates this modification, where three sound amplifiers, D D D, are shown as connected by wires or threads to the elastic vibrator.

EDISON'S RECENT TELEPHONIC INVENTIONS.*

The device of using several pieces of semi-conductor instead of one was early tried by Mr. Edison. He found that in general the loudness of the sound was increased by multiplying the number of contact surfaces.

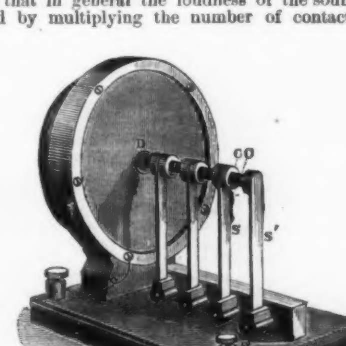


Fig. 1.—EDISON'S MICROPHONE.

Instruments of this nature have now become known as microphones. Fig. 1 shows one of the first forms invented by Mr. Edison. Four pieces, C, of charcoal are used, each supported by an upright spring, as at S and S'. The piece of charcoal nearest the diaphragm impinges upon a disk, D, of carbon, which is fastened to the center of the diaphragm. The primary wires of an induction coil are attached to the diaphragm and the springs, S. A Bell telephone is connected with the secondary wire of the induction coil. The circuit is then completed through the semi-conductors.

* From Prescott's "Speaking Telephone, Electric Light, etc."

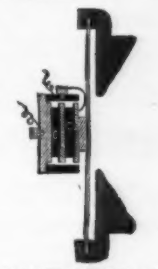


Fig. 2.—MICROPHONE WITH CARBON DISKS.

Another form is shown in Fig. 2. It has two carbons, C C, separated by a plate of metal.

Fig. 3 represents a microphone having ten plates, S, of silk. The silk is prepared for use by working into its pores a mixture of dextrine and lampblack.

Fig. 4 represents Edison's pile telephone. A piece of cork, K, is fastened to the diaphragm, and presses upon a strip of platinum which is attached to a plate of copper. The latter is one of the terminals of an ordinary galvanic pile. The other terminal plate presses against the metallic frame of the instrument. When the pile is included in a closed telephone circuit it furnishes a continuous current. The strength of this current depends upon the internal resistance of the pile and its polarization, and these are varied by vibrating the diaphragm. The pile is composed of alter-

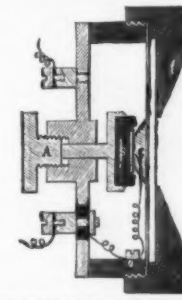


Fig. 3.—MICROPHONE WITH SILK DISK.

nate plates of zinc and copper, Z, C, and a bibulous medium, G, between the pairs of plates.

In Fig. 5 a condenser telephone is represented. In this instrument the plates are arranged as in the ordinary form of condenser. An initial pressure is put upon them by a screw bearing in the solid frame of the instrument. The

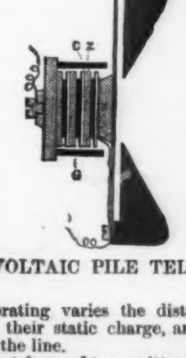


Fig. 4.—VOLTAIC PILE TELEPHONE.

diaphragm in vibrating varies the distance between the plates; this alters their static charge, and affects also the electric tension of the line.

Mr. Edison's latest form of transmitter is shown in Fig. 6. The prepared carbon, C, is contained in a hard rubber block,

open throughout, so that one side of the carbon is made to rest upon the metallic part of the frame which forms one of the connections of the circuit. The opposite side of the

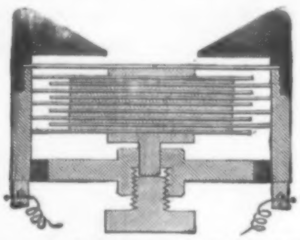


Fig. 5.—CONDENSER TELEPHONE.

carbon is covered with a circular piece of platinum foil, P, which leads to a binding post insulated from the frame, and forming the other connection for placing the instrument in the circuit. A glass disk, G, upon which is placed a projecting knob, A, of aluminum, is glued to the foil; and the diaphragm, D, connecting with the knob serves, when spoken against, to communicate the resulting pressure to

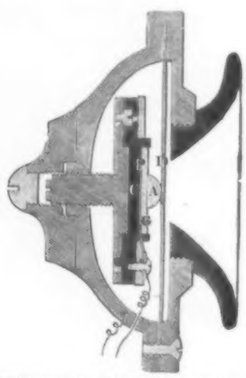


Fig. 6.—EDISON'S CARBON TELEPHONE.

the carbon. A substantial metallic frame surrounds the carbon and its connections and protects them.

This instrument is mounted upon a projecting arm, with a joint in each end, as shown in Fig. 7. The lower end of the arm is secured by means of a joint to the disk. This arrangement permits of placing the telephone in a convenient position for speaking purposes.

Fig. 7.—ARRANGEMENT OF TELEPHONE FOR OFFICE USE.

Edison's telephone depends wholly on the battery for its power, and not upon the voice, as is the case with other telephones. All that is required is that the words should be spoken distinctly and in the ordinary tone of voice.

Fig. 7 shows a convenient way of arranging the telephone apparatus for shop, counting-room, and other purposes.

Fig. 8.—SINGLE-CROWN TELEPHONE.

The carbon telephone is jointed to a projecting arm, and the Phelps crown instrument is used as a receiver, the call being given by an ordinary telegraph sounder and key for interrupting the circuit. The switch at the back serves for putting the telephone in and out of the circuit. The small induction coil used with the apparatus is placed beneath the desk and in position where it is not liable to damage. When the switch is turned as represented in the cut, the apparatus is in proper condition for speaking purposes; when it is turned to the opposite buttons, which is its normal position when not in use, the telephones are cut out of the circuit, the sounder, battery and key alone being then included. The same battery is used for both signaling and talking. The receiving instrument, which is shown in connection with the Edison telephone, is the Phelps crown telephone (Fig. 8). It is composed of the ordinary diaphragm, electro-magnet, or soft iron pole piece, and several steel bars that have

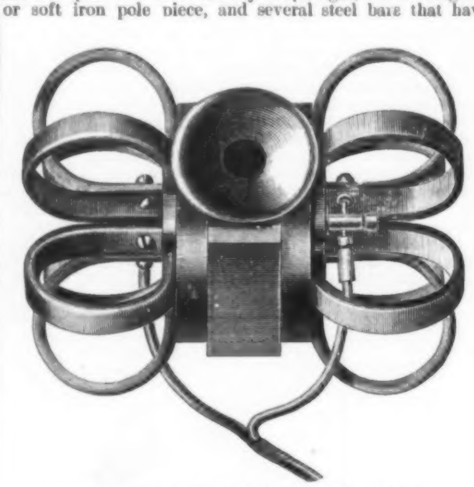


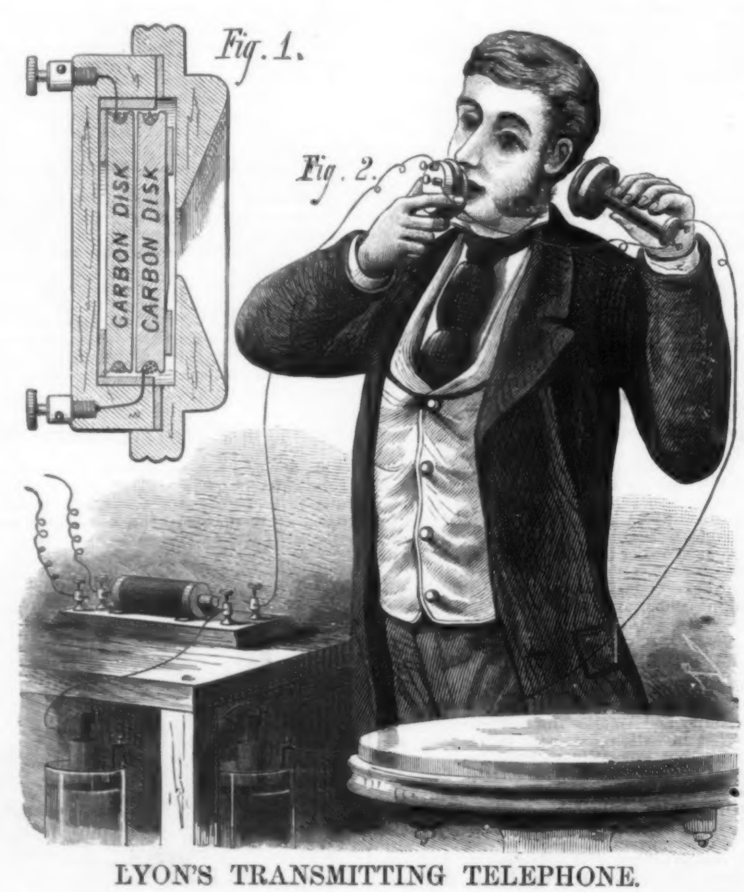
Fig. 9.—DOUBLE-CROWN TELEPHONE.

previously been rendered permanently magnetic. These magnets, usually six in number, are bent into a circular form, and have three like poles joined to one end of the core, which carries the magnetizing helix and radiates from it in as many different directions. The opposite poles are joined to the periphery of the diaphragm, which is contained in a case of polished hard rubber and faces the free end of the soft iron core. Fig. 9 represents a double crown instrument, which consists of two single-crown instruments joined together, with a common vocalizing chamber between them.

A NEW FORM OF TRANSMITTING TELEPHONE.

Notwithstanding the multitude of telephones which have been perfected within the last two years, it seems that the subject is far from being exhausted. The accompanying engravings show a very simple and effective transmitting telephone, devised by Mr. Edward H. Lyon, of Brooklyn, N.Y.

The manner of using the instrument will be readily understood by reference to Fig. 1, and the details of its construction are shown in Fig. 2. This instrument is used only as a transmitter, the Bell telephone being used as



LYON'S TRANSMITTING TELEPHONE.

a receiver. The transmitter is placed in a local circuit, and connected with the primary wire of a small induction coil, as shown in Fig. 1. The secondary wire of the coil is in the main line, which may include several receivers of the Bell form. It is stated that, with a main line of considerable length, say, three or four miles, no ground connections are required.

This telephone, as will be seen by reference to Fig. 2, consists of two similar carbon disks, 1⅛ in. diameter, ¼ in. thick, having a groove around the edge for receiving fine copper wires, which pass several times around them, and communicate with the binding posts. The disks are cut from ordinary battery carbons of the proper thickness, and requiring no preparation, beyond rubbing together slightly to bring them to a surface.

The casing, which is of wood, consists of two parts, one being chambered to receive both carbon disks, the other having a mouthpiece formed in it with a central opening ⅝ in. in diameter. The lower carbon is rigidly held in position by the felt or cloth lining of the casing; the upper carbon disk is loose and rests upon the lower one. The outer surface of the upper carbon disk is varnished with shellac, and provided with a ring of blotting paper to absorb moisture.

The two binding posts are placed in the local circuit, as before explained, and the receiving telephone is connected with the secondary wire of the induction coil.

This transmitter needs no adjustment, it being only necessary to place it in a slightly inclined position to bring it into adjustment. With this instrument speech is transmitted very clearly and quite loudly, with the timbre of the speaker's voice. Singing and various kinds of instrumental music are transmitted beautifully.

The inventor attributes the effectiveness of the instrument to the utilization of the entire surface of the disks, the encircling wire insuring an even distribution of the current throughout the entire disk.

THE WATCH TELEPHONE.

This form of telephone, as will be seen from the illustra-

tion, takes its name from its likeness to one of the old-fash ioned "turnip" watches. The figure shows its full size, and it is the smallest kind of Bell telephone yet made. The magnet is bent into a circular form, and the coil is seated upon one of its poles, the planes of the magnet, coil, and diaphragm being all parallel to each other. The articulation is as distinct as with the larger telephones. This convenient form of telephone, which can easily be carried in the pocket, is a design of M. Alfred Niaudet-Breguet, Paris, to whom we are indebted for the illustration.—*Telegraphic Journal.*

SOME MODIFICATIONS OF THE MICROPHONE AND TELEPHONE.

By GEO. M. HOPKINS.

THE microphone now exists in many forms, and is an exceedingly interesting instrument, although it has not, thus far, attained the usefulness of the telephone. The several

FIG. 1.—MICROPHONE WITH GRAPHITE RODS.

forms of microphone are easily constructed, but all, so far as I know, are defective in some particular. An instrument of this sort that is sensitive enough to transmit the slightest sounds is too sensitive to transmit the heavier sounds properly. In the instruments shown in Figs. 1, 2, and 3, these defects are in a great measure remedied. These microphones

FIG. 2.—MICROPHONE WITH PENDANTS.

are so simple and so easily made that I give a description of each, so that any one who wishes to experiment in this direction may be able to do so.

The instrument shown in Fig. 1 has a wooden diaphragm one-eighth inch thick and four inches square, which is glued

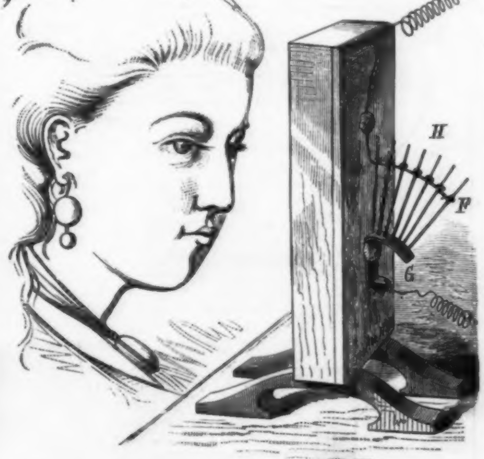


FIG. 3.—MICROPHONE WITHOUT CARBON.

to a narrow frame supported by suitable legs. Two pieces of battery carbon, A B, are secured by means of sealing wax to the diaphragm about an inch apart and at equal distances from the center. They are both inclined downward at about the angle indicated in the engraving, say 30°. The carbon, A, is longer than the carbon, B, and has in its under surface three conical holes—made with a penknife point—which are large enough to receive the upper ends of the graphite pen-

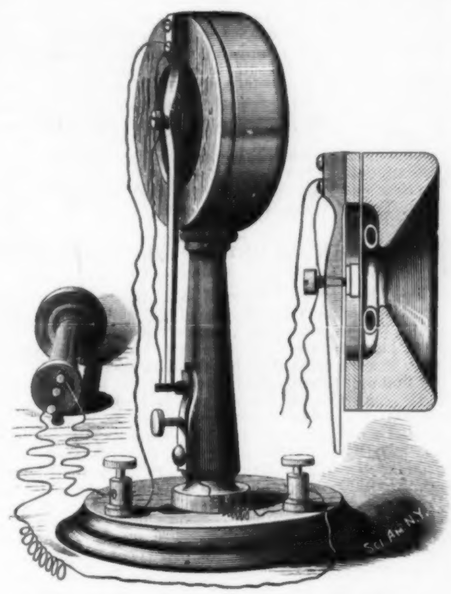


FIG. 4.—NEW FORM OF TELEPHONE.

cils, C. The lower ends of the pencils rest in slight cavities in the lower carbon. The pencils, C, are simply pencil leads sharpened at each end and placed loosely between the carbons; they are inclined at different angles, so that the motion of the diaphragm which would jar one of them would simply move the others so as to transmit the sound properly. Battery wires, which are connected with a telephone*, are attached, one to the carbon, A, the other to the carbon, B.

FIG. 5.—A NEW MICRO-TELEPHONE.

The diaphragm and its support in Figs. 2 and 3 is the same as that already described. The microphone shown in Fig. 2 has a piece of battery carbon, D, secured in an inclined position to the diaphragm near the middle, by means of sealing wax. Three carbon pendants, E, of different sizes, are suspended by very fine wires, so that they rest upon the upper surface of the carbon, D. The three fine wires are all connected with one of the battery wires, and are fastened at suitable distances apart to the face of the diaphragm by

FIG. 6.—MICRO-TELEPHONE ON A VIOLIN.

a drop of sealing wax. A fine copper wire is wound around the carbon, D, and connected with the battery.

The construction of the microphone shown in Fig. 3 is so obvious as to require little description. One of the battery wires terminates in a series of coils, F, and is attached to the diaphragm above the middle. The other wire is connected with a strip of metal, G, which is secured to the diaphragm below the middle, and is curved and indented to receive the wires, H, which, by the way, must be quite fine, say No. 30.

These instruments are used as transmitters; a Bell telephone is used as a receiver. By using a number of rods, pencils, or pendants instead of a single pencil, as in the Hughes microphone, much if not all of the jarring is avoided, while it is capable of performing the feats usually expected from instruments of the name, such as the transmission of the sound of the ticking of a watch, the tramp of a fly or an ant, the crumbling of paper, whistling, instrumen-

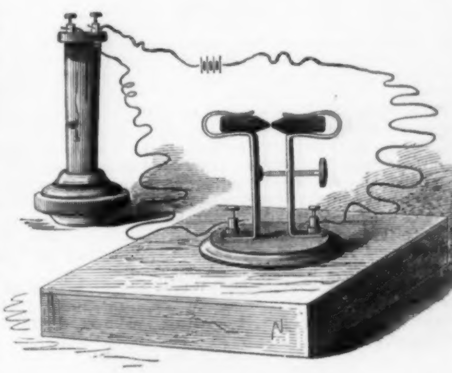


FIG. 7.—MICRO-TELEPHONE ON A PLAIN SOUNDING BOARD.

tal and vocal music, and, under the proper conditions, articulate speech, whispering, etc.

The instrument shown in perspective in Fig. 4 and in section annexed fulfills the requirements of both microphone and transmitting telephone, being capable of transmitting articulate speech as loudly and clearly as any of the well-known forms of telephone. It is not necessary that one should speak directly into the instrument; it may be in one part of the room and the speaker in another. It will transmit a whisper, or the conversation of two or three persons, and it is partial to violin and flute music or whistling. It seems almost incredible that an instrument of this construction should do these things, as everything is accomplished

FIG. 8.—MICRO-TELEPHONE USED AS A TELEPHONE.

through the medium of a long lever actuated by the diaphragm; but this construction amplifies the vibrations of the diaphragm, and renders the instrument effective. The mouthpiece, which contains a ferrotype diaphragm, is mounted on a standard, and the diaphragm is damped as in the phonograph by means of short pieces of rubber tubing placed between it and the mouthpiece. A wooden spring is attached to the diaphragm support, and extends across the diaphragm downward toward the base of the standard. A small set screw passes through the spring and bears upon a thin metal plate that rests upon a soft rubber block, placed against the center of the diaphragm. The spring between the set screw and the fixed portion is reduced somewhat in thickness, and from the set screw to the lower end it is tapered to make it as light as possible. A small pencil of battery carbon is cemented to the extreme lower end of the spring, and a very fine copper wire is wound around it and carried upward to the fixed portion of the spring, thence downward to the binding post at the left. A small metallic spring is secured to the standard near the base, and carries at its free end a block of battery carbon, which is brought into light contact with the carbon on the end of the wooden spring by turning the adjusting screw that passes through the metal spring and bears against the standard. The metal spring is connected with the binding post at the right. This instrument, placed in an electrical circuit in which there is a Bell telephone, will transmit speech with considerable loudness. It requires no call or alarm, as a loud sound made directly into the mouthpiece will produce a noise in the receiving instrument which may be heard in any part of a room of ordinary size.

The instrument which is shown in Figs. 5, 6, 7, 8, consists essentially of two springs secured to a small base piece, and each supporting at their upper end a piece of ordinary battery carbon. These two pieces of carbon are placed in light contact, and two springs are put in an electrical circuit, in which there is also a receiving telephone of the Bell form.

* Full directions for making telephones in SCIENTIFIC AMERICAN SUPPLEMENT, No. 142.

This instrument is represented full size, in detail, in Fig. 5. In Fig. 6 the micro-telephone is placed upon a violin. In Figs. 7 and 8 it is secured to a small sounding board. The two carbon supporting springs are fastened to a single base by the binding posts which receive the battery wires. An adjusting screw passes through one of the springs at or near its center, and bears against a rubber button projecting from the other spring. This simple device when placed on a table indicates in the receiving telephone the slightest touch of the finger on the table or on the instrument. Blowing on it makes in the receiving instrument a deafening roar; drawing a hair or a bit of cotton across the carbon is distinctly audible in the receiving instrument.

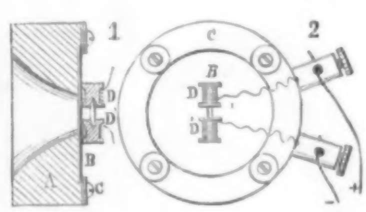
When the device is placed on a small sounding board every sound in the room is received and transmitted. An ant running across the sounding board can be plainly heard. And a touch upon the instrument or the table which supports it, which without the micro-telephone would be entirely inaudible, can be distinctly heard in the receiving telephone by aid of the instrument, even though miles intervene.

When it is placed on a violin, as in Fig. 6, blowing lightly upon the strings produces Æolian harp tones in the receiver, and a song sung to the violin is rendered in the receiving instrument with an Æolian harp accompaniment. When mounted on a violin or sounding board it will transmit articulate speech uttered in any portion of a room of ordinary size; it will receive and transmit the music of a piano, and even the turning of the music may be heard. Whistling, flute music, and other sounds are transmitted with their characteristics of volume, pitch, and timbre.

This instrument, although so very simple, is capable of doing all that has been done by other instruments of an analogous character, but it requires the most delicate adjustment.

A SIMPLE MICROPHONE.

THE mouthpiece, A, is turned from walnut, and a ferrotype plate, B, 2¼ inches in diameter, attached, a light ring of blotting paper being placed on each side at its edge, and the whole secured by screwing over it a flat iron ring, C. Two little cups of gas carbon, D, D', are securely glued upon the disk as near its center as possible. In their cavities rest loosely the ends of a pointed rod of graphite, or pencil lead, about $\frac{3}{16}$ inch long and $\frac{1}{16}$ or $\frac{1}{8}$ inch thick. Around the body of each cup is carefully wrapped the exposed end of a piece of insulated copper wire, the other end of which is in connection with its binding screw. Interposing the microphone thus made, and a Bell telephone, in the circuit of one or two Grenet cells, the slightest scratch or rub of a feather was at once audible. The usual experi-



ments with the microphone have been sufficiently described to obviate the necessity of repetition here. Placing the mouthpiece of the present instrument upon my body, a listener with the telephone at the other end of the line, about 200 feet distant, was able distinctly to hear the beating of my heart. The same was still audible, though more faintly, when merely a single finger was placed on the ferrotype plate, and even when the contact was made by means of a short steel rod held between the fingers, while the further end rested as near as convenient to the middle of the disk. This experiment has been successfully repeated with different auditors. Thus far this form of microphone has not yielded satisfactory results when used as a telephone transmitter of articulate speech. Vocal music is taken up by it, but the reproduction is somewhat harsh.

NEW STETHOSCOPIC MICROPHONE.

BY means of this apparatus of MM. Ducretet & Co., of Paris, the feeblest pulsations of the heart, pulse, and arteries may be heard in several telephones placed in circuit. It is a very delicate instrument, and exquisitely sensitive, and this is its fault, if it have any.

Two tambours, such as devised by M. Mavey, are coupled to a microphone; one of these, T', serves as a searcher; the other, T, as a receiver. The feeblest movements communicated to the tambour, T', act through the medium of the India-rubber tube which unites them, upon the tambour, T, and consequently, on the lever microphone, L, the sensitiveness of which can be regulated by the counterpoise, P O. The microphone terminates in a pencil, C, formed of retort carbon or of plumbago, which rests on a disk of the same material fixed on the receiving tambour. The whole forms a complete circuit, in which is a Daniell or Leclanché battery of one to three elements, and the telephones through which are heard the pulsations from the searching tambour, T'.

This microphone is susceptible of modification, and will undoubtedly be the means of more extended physiological observations. By substituting a small funnel for the tambour, T, speech may be transmitted.

A REPORT ON UNDERGROUND TELEGRAPH WIRES.

THE Chicago City Council has under consideration the feasibility of carrying the fire alarm, police, and water telegraph wires underground, and in connection with the project, the superintendent of the city telegraph system, Mr. J. P. Barrett, has submitted the following report.

I find that the principal portion of the telegraph wires in the leading cities of Europe are laid underground, and in the city of London there were, in 1875, 3,500 miles of underground wire belonging to the government telegraph system, and in Paris, about the same date, all the wires were underground. In Germany there are several underground telegraph lines, between one city and another. For instance, Berlin is connected with Hamburg, Mayence, Strasbourg, Cologne, and many other cities by underground lines the entire distance. The wires are run underground in the cities of Berlin, Dantzic, Stettin, Hamburg, Bremen, Cologne, Frankfort-on-the-Main, Mayence, Carlsruhe, and other large cities and towns of Germany; and in Geneva, Lausanne, Berne, Neufchatel, Zurich, Winterthur, Schaffhausen, Saint Galle, and Lugano, in Switzerland. In nearly all the cities of Europe neither posts nor wires are visible, but the system of underground cables is adopted instead.

These cables contain from five to seven conductors each, insulated with gutta percha, and the whole protected with an armor of iron wires. This system has shown itself in practice to be both economical and reliable. There are now in Paris working lines that have been buried for twenty-five years, and which have been the cause of little or no expense.

The annexed table gives the length of the conducting wires employed in the fire alarm telegraph system of the various prominent cities in Europe that have placed their wires underground with satisfactory results:

	Feet of Wire.
Frankfort-on-the-Main	95,234
Amsterdam	233,040
Berlin	738,000
Stettin	17,056
Magdeburg	43,670
Hamburg	151,631
Cologne	59,696
Dusseldorf	33 882
Leipzig	54,540
Dantzic	2,302
London	155,640
Paris	All lines.

The different systems of underground wires hitherto employed are these: The larger proportion of the work which has been done has consisted of copper wire, insulated first with gutta percha, and the gutta percha protected from the action of the atmosphere by a covering of tar and tarred tape. The wires so protected are bunched together in a sort of cable and drawn through an iron pipe. In some cases the wires, after being insulated with gutta percha, are protected by a series of galvanized iron wires, laid spirally around the cable. The pipes containing the wires have been generally laid in the ground at a depth of two and a half or three feet below the surface. In Paris the cables are coated with a lead covering and hung in the sewers.

Another method of insulating and protecting underground wires has been by the use of an insulator known as kerite, which is a form of vulcanized rubber, especially adopted as a telegraph insulator, and the copper wires, after being insulated with kerite, are laid in lead or iron pipe or wooden boxes under the ground.

Another method of Professor Brooks, of Philadelphia (late United States Commissioner to Vienna International Exhibition), has been successfully employed within the past two or three years, which consists in covering the copper wire, by winding or braiding with cotton thread, depriving the thread of its moisture so as to secure a high degree of insulation, bunching the wires together, as many as are required on a given route, drawing them into an iron pipe, and filling the pipe and keeping it full of specially prepared paraffine oil. (The paraffine oil serves to keep out moisture from the pipes and to insulate the wires.) Cables laid upon this system have been in satisfactory operation for more than a year, showing no signs of deterioration.

There are many advantages in the use of underground lines of a special importance for the fire alarm telegraph service, in their almost absolute freedom from sudden and unexpected interruptions, owing to high winds, storms, fires, accumulations of ice and sleet, and consequent freedom from the cost and trouble of repairs, which with overhead lines, even when constructed in the best manner possible, are of frequent occurrence. Interruptions to underground wires, as compared with overhead wires, are stated to be (based on experience in European cities) as one to a thousand. This advantage would render the fire alarm telegraph system more reliable and efficient. The disadvantages may be briefly summed up in the four words—original cost of construction.

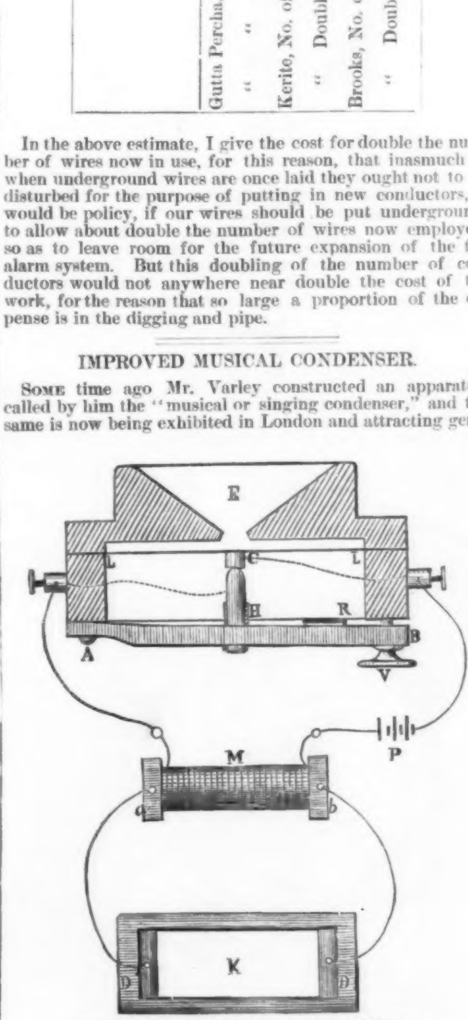
Upon a careful estimate of the cost of laying underground in Chicago all the wires that we are now using, I find that the cost of each would be as follows:

METHOD.	WIRE.	Digging and filling.	Removing and Replacing Pavement.	Total cost.
Gutta Percha, No. of wires now in use	103,725	$34,815	$6,135	$144,675
" Double No. now in use	148,725	do.	do.	189,675
Kerite, No. of wires now in use	132,725	do.	do.	173,675
" Double No. now in use	222,725	do.	do.	263,675
Brooks, No. of wires now in use, cotton covered,	60,000	do.	do.	100,950
" Double No. now in use, cotton covered,	70,000	do.	do.	110,950

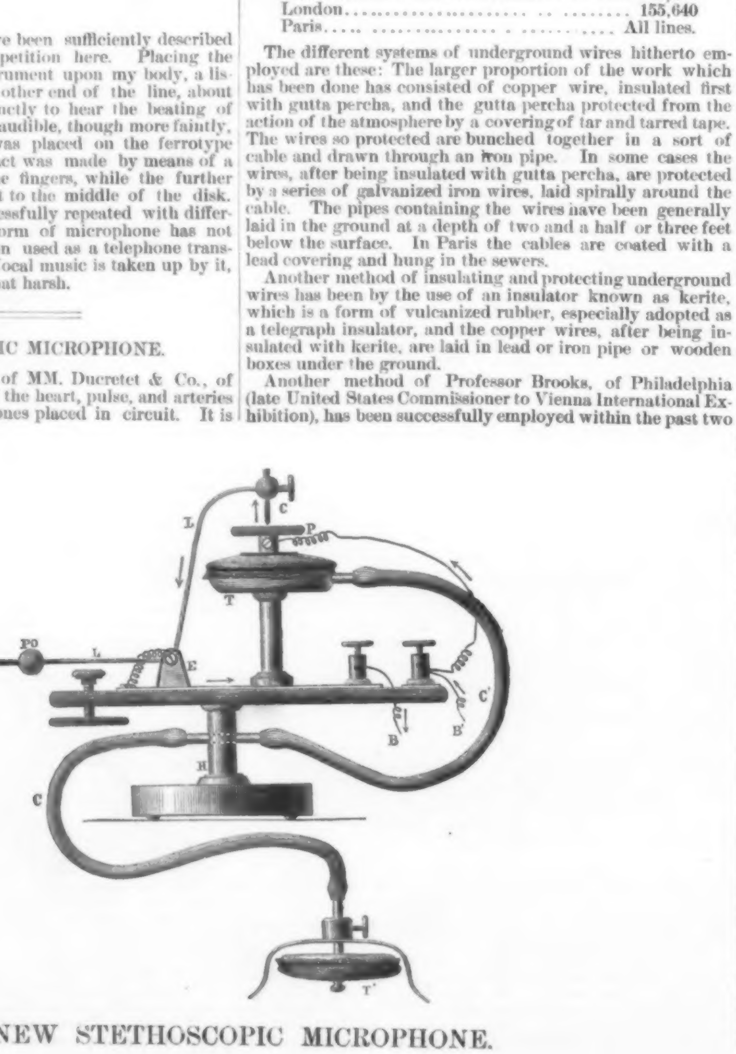
In the above estimate, I give the cost for double the number of wires now in use, for this reason, that inasmuch as when underground wires are once laid they ought not to be disturbed for the purpose of putting in new conductors, it would be policy, if our wires should be put underground, to allow about double the number of wires now employed, so as to leave room for the future expansion of the fire alarm system. But this doubling of the number of conductors would not anywhere near double the cost of the work, for the reason that so large a proportion of the expense is in the digging and pipe.

IMPROVED MUSICAL CONDENSER.

SOME time ago Mr. Varley constructed an apparatus, called by him the "musical or singing condenser," and the same is now being exhibited in London and attracting general attention. The apparatus, like so many others of similar character, is too complicated and incomplete for practical purposes. It consists of the receiver, the trans-



VARLEY'S MUSICAL CONDENSER.



NEW STETHOSCOPIC MICROPHONE.

mitting apparatus, and the condenser. The latter, K, is composed of a pile of leaves of paper and tinfoil, following alternately; the pairs 2, 4, 6, etc., are united together at one end; the pairs 1, 3, 5, etc., at the opposite end. The whole is inclosed by copper frames, D D', supplied with screws to connect the wires. The sheets may be firmly compressed, the operation not being disturbed thereby in the least.

The receiving and transmitting apparatus consists of a sort of telephone, E. The place of the diaphragm is filled by a sheet of metal foil, L L, in the center of which is fastened a cylindrical piece of carbon, G. Against the latter is placed a second carbon cylinder, H, resting on a wooden cross piece, A B, fastened at A to one wall of the case, B, by means of a regulating screw, V, to the other wall. A spring, R, extending across the board, A B, imparts to the latter a certain degree of elasticity, which is necessary to insure success.

The metal sheet receiving the sound is connected with one of the poles of a battery, consisting of six Leclanché cells; the lower carbon cylinder is connected with the primary helix of the induction coil, M, which connects on its part with the other pole of the battery. Finally the two poles of the secondary helix of the coil are connected with the ends, D D', of the condenser.

The secondary helix of the coil consists of twenty layers of No. 32 wire, well covered with silk; the primary helix consists of five layers of No. 16 wire. The length of the coil does not exceed 2¾ inches, and the core is ⅜ inch thick.

The receiving and transmitting apparatus must be regulated by experimenting. The two carbon points, when at rest, should not touch each other, but must be brought into contact by the slightest vibration of the metal sheet. The right position may be determined as follows: When the same note is repeatedly sounded into the collector, the carbons may be approached till the sound is distinctly reproduced. When three notes, sounded in succession into the collector, are plainly heard from the condenser, the apparatus may be considered sufficiently well regulated. The melody must be sung into the receiver while the mouth is placed as near as possible to the entrance. Voices resembling the sound of a flute are most easily reproduced.

The apparatus may be used in the same way as Edison's telephone. When it is used as a microphonic receiver, the carbon points must be brought into contact.—*L'Electricité.*

THE CONDITIONS OF HEALTH IN THE INFANT.

A Lecture delivered at Jefferson Medical College, Philadelphia, Pa., by WM. B. ATKINSON, M.D.

IT is absolutely impossible to judge correctly of any diseased condition of the human frame, unless we previously have a thorough knowledge of that frame in a state of health. This proposition is so self-evident that it is unnecessary for me to do more than make the statement. While this is true as to adults, it applies with equal force to the cases of children. We carefully study the anatomy and physiology of each organ, its relations to other organs, and the conditions of the body as an accumulation of these parts. So it behooves us to study the child, to familiarize ourselves with it in every way, from the moment of birth up to the time when it and its disease may be regarded as no longer peculiar, but as coming under the ordinary heading of diseases of adult life.

Feeling the necessity of such a study, and knowing well that the books are almost completely silent on this important point, I have deemed it well to devote this lecture to the consideration of healthy children, and what we should expect to find in them.

At the moment of birth the infant changes entirely its mode of life. From a condition peculiar to itself, it changes, at a bound, to the condition of a breathing animal. Hitherto its lungs have been in a dormant state, their cells flaccid; now these cells expand, the air suddenly rushes into them and fills them, gradually, to their utmost capacity. The blood no longer flows through the umbilical cord, but passes by a new route through the lungs, and as it passes is wonderfully changed and vivified by the reception of oxygen from the air in the lung cells, burning out the effete black matters which but recently loaded it. The child has become "a living, breathing soul."

From a condition of almost perfect rest, its limbs and body folded upon themselves so as to occupy a remarkably small space, it assumes the role of an active, moving being. This is an especial point; a healthy infant, save when asleep, is almost constantly in very active motion. But as the little being commences to grow very rapidly, it requires a great deal of food and rest to enable it to progress; hence, we find that an infant sleeps two-thirds or three-fourths of its time.

But before we attempt the consideration of its habits, it would be well to give you some idea of its appearance. The average infant at birth measures about eighteen inches in length. As I have just said, it commences to grow very rapidly, and so continues, but each year slightly diminishing the increase. Thus, for the first year, it grows at such a rate that by the close of the year it has attained a length, of say 26 inches; during the second year the increase is less, of about four inches; say half as much as that of the first year; the third it again is lessened, amounting to three inches, and thus it continues, averaging from this time about two or two and a half inches each year, slowly decreasing, until from the fourteenth or fifteenth year the child rarely gains more than one inch each year.

The weight is usually seven and a half pounds. On this point we are continually liable to deception. Again and again I have been assured of extraordinary weights, or conjectures have been made, but the test by a pair of good scales or the little standard scales now so often met with in many households, will reveal a very small number of children above the weight of eight pounds. The general rule is that female infants are a trifle shorter and lighter than males. In the case of twins the two generally weigh about ten and a half to eleven pounds. At the end of the year the infant's weight has increased to about twenty pounds; and the increase goes on at the rate of four or five pounds by the end of the second year, and year by year from four to seven pounds. Marked variation either way, as to length or weight, does not constitute disease, though these points should be considered when a prognosis i required as to probabilities of life, etc.

The color of the skin is of a deep pink tint; the skin being delicate and highly vascular. The peculiar cheesy covering so often found tenaciously adhering to the surface of many new-born infants, technically called *vernix caseosa*, varies greatly in profuseness, and in a large number of children is entirely wanting. I have not observed any difference as to the health of children in relation to the absence or profuseness of this matter. General desquamation of the cuticle, to a greater or less extent, occurs within a few days.

The body and limbs are soft, not flabby; giving rather the sensation to the hand of fatness, and in reality the majority of infants are plump and in good condition, even when the mother has been poorly nourished during pregnancy.

The appearance of the child is rather as though the head and body had been nourished, to the neglect of the limbs, but this is solely due to the fact that the limbs have been almost perfectly quiescent. We find that the muscles are deficient in fibrine, hence they are soft and destitute of that firmness which they subsequently acquire by the almost constant use to which they are put by the child in its varied movements.

The bones are relatively small, and greatly deficient in earthy matter, being almost wholly cartilaginous. Hence it is that they yield so readily to force, not breaking, but bending, and finally, when bent too far, we have produced what is technically called the "green-stick" or partial fracture—the bone being broken on one side and bent on the opposite. This want of strength in the skeleton is important to be known, in order that care may be taken not to expose the child to injury by the upright position at a very early age, and especially by those efforts, so common with fond mothers and nurses, of placing children too soon on their feet, in the desire to see them commence to walk. We may almost always depend upon the child itself in this matter, as it instinctively endeavors to place itself erect when it feels that its legs are able to bear the weight placed upon them. Another important point is to remember that the shafts of the long bones and their epiphyses ossify at different periods; and that these epiphyses are almost loose, as it were, or so slightly joined to the bones that a very trifling force will separate them. The solid union is rarely completed until after the age of puberty, say the fifteenth or sixteenth year. The bones of the skull are separated by divisions covered by membrane, and these lines become subsequently the sutures, or lines of ossific union of the bones. At the points where these sutures unite or cross each other, ossification is still less complete, and slower in its progress, so that large openings, the fontanelles, present. These are familiarly called the "moulds of the head." There are several of these, but the two most prominent and important are the anterior or larger fontanelle, formed by the two frontal and the two parietal bones, shaped like a trapezium, with the anterior angle most acute, and the posterior or small fontanelle, which is formed by the two parietal and the occipital bones. This is very much smaller, and is usually ossified much earlier than the anterior, which remains in a membranous state until the child has acquired some age. The fifth year is usually the age at which these openings have become completely filled by bone.

Generally, at the moment of birth there is some hair on the scalp, but when this is unusually long and thick it falls out, and is gradually replaced by the permanent growth.

The pulse of a new-born child is markedly rapid and soft, and is easily affected by the slightest causes, as emotion, or position, and even varies at different periods of the day. The heart, though large, proportionally, is soft and pale. It contracts and dilates at an average rate of 120 times in the minute. But though the pulsations in children are always more frequent than in adult life, yet this great frequency soon begins to lessen, and by the fifth year it has fallen to 85 or 90 beats.

On this subject Tanner gives the following conclusions: "In young infants no signs can be deduced from the fullness or hardness, the strength or weakness, of the pulse, since, generally, these distinctions cannot be even recognized. The pulsations are often irregular without any disease being present. They are very frequent, the pulsations varying from 100 to 120 a minute; the average quickness being about 104 for children under five years of age. They diminish gradually as the period of weaning approaches, continuing to do so until adult age, when they are about eighty. Sex has no influence up to the age of seven years; after that the female pulse becomes slightly quicker than that of the male. Sleep lowers the frequency by about eighteen or twenty beats, and makes it also more regular."

The respiration is the first action of the child. The moment it is extruded from the parts it involuntarily draws in the air, expands the cells of the lungs, and at the same moment there commences the change by which the blue or venous blood is changed into arterial or red blood.

At all ages the act is without any regularity. The individual, while deeply intent upon some pursuit, neglects, as it were, to inspire fully, and by and by the wants of the system compel him to take in a full, long breath. This is equally the case in all stages of childhood, though the respiration becomes more decidedly regular after the close of the second year. It must be understood that the child does not for some time fully expand its air cells. This is a gradual process. The act of inspiration in very young children is almost wholly by means of the diaphragm and abdominal muscles; there is but slight dilatation of the chest. Of course, during sleep, the respiration becomes more regular and tranquil. The number of respirations is about thirty during sleep, to forty during the waking moments. As I have said already, this act is so readily affected by the most trivial causes, and may jump in a moment, as it were, to double the number of the usual average of respirations, that it can enter but to a limited extent into our diagnostic means.

The temperature internally is quite uniform. It varies but slightly from that of the adult.

During the first few days or a week it is rather lower, the average being about 98·5°, while subsequently it ranges about 99°. Of course, the temperature externally varies as that of the atmosphere to which it is exposed.

We next come to the digestive system. Here we find many points which are of great importance to bear in mind. The mouth seems especially modeled at this time for the act of sucking, by the absence of teeth and by the disposition of the lips, palate, and posterior nares. At a very early period taste appears to be entirely absent, for we find the new-born infant readily accepting even quite nauseous substances. But this does not long continue, for it is soon noticed that the little one quickly discriminates between bitter and sweet or aromatic fluids. The organs of digestion are ready for the most active duty; and hunger and thirst are perhaps the earliest sensations after the first hours of life.

Saliva is not secreted until after the third month. The alimentary canal is much less tortuous than in later years, and the angle by which the œsophagus is joined to the stomach is an obtuse one, and hence the act of vomiting is a matter of great ease in the case of children. This is one of the admirable provisions of nature to enable the little patient to eject the contents of its stomach, which may often serve as a prophylactic against additional intestinal troubles. We may really denominate this regurgitation, rather than vomiting. Nor is this all, for we find that articles of food which must have passed out of the stomach into the lower bowel are very frequently ejected by the mouth. Again, we find, by the ease with which the fecal dejections are passed, that the bowels are much less tortuous in their course. All the digestive organs are less perfectly organized than in after life; yet they are fully in a condition to digest rapidly and completely the appropriate aliment so necessary to supply the material with which to build up the entire structure. In fact, the stomach has so little work to do in comparison with its after duties, that in the infant it is but little more, in form and purpose, than an enlargement of the tube at this point. Showing that its function is not to retain the food for a long time, as in adult life, and there subject it to the process of digestion, but that the food is really to be brought into its cavity almost fully ready for the changes which are to occur as it is conveyed rapidly on into the blood vessels. The capacity of the stomach of the infant is not very great. Perhaps half a pint placed at one time within it will be sufficient to fill it uncomfortably full. About four to six ounces of food is the average amount of liquid nourishment taken at each time of sucking. So rapidly is digestion accomplished, that in about two hours this is digested, and nature again demands a supply. This is the rule, with variations according to circumstances, throughout the day. But at night the majority of infants arouse from their slumbers about once in six hours, and require to be nursed. Much, here, however, depends upon habit. By care, many mothers succeed in accustoming their infants to a much longer interval at night, and thus secure for themselves a more comfortable rest. Those mothers who allow themselves to give the breast to the child at every moment of restlessness, or on every occasion that they may take the child into their arms, soon accustom the little one to demand it, and they rapidly place themselves under the caprices of a tyrant whose claims are galling, even though they are covered with the velvet covering of maternal love.

When nursing, the infant sucks until it is satisfied, unless some interruption occurs. Hence, this point, as to the quantity of food to be taken at once, need only claim our attention in cases where artificial feeding becomes necessary.

The act of nursing on the part of the child should never be one indicating effort. A healthy nipple and breast give forth the supply with but little solicitation. A healthy child draws its nourishment without effort, and with evident pleasure. During the act of sucking it must not be forgotten that the respiration is necessarily performed through the nose. Hence its distress when, from any cause, that organ is obstructed.

Vomiting, or rather, regurgitation, constantly occurs in healthy children, as a result, almost always, of an over distention of the stomach. In these instances it comes up with little or no change, often just as it was drawn from the breast.

Many infants quietly draw the milk, and as they become satisfied, gradually fall off into a sound, refreshing slumber. This is well, as the stomach is permitted, without disturbance, to digest and dispose of the milk. Too many people, such as fond fathers, etc., forget their own sensations after a full meal, and snatch the little one from its mother's arms, as it lies back in pleasant contentment, and the next moment it is tossed into the air, tickled, to make it laugh, trotted roughly on the knee, all as though the little stomach was a churn, and the effort was now being made to convert its contents, as rapidly as possible, into butter. Cheese, of a very indigestible form, is the usual result, and fortunately for the child, it also usually ejects said result over the clothes of its fond entertainer.

The bowels should be, immediately after birth, evacuated of a dark-greenish or blackish matter, of a tarry consistence. This is called the meconium, and generally, under the aperient action of the colostrum, or first milk of the mother, it is completely cleared out by the end of the second or third day. Then the discharges become of a soft, curdy appearance, almost without odor, and of a dark yellow color. During the whole of infancy, at least until the food becomes of a more solid character, the evacuations are soft and of a light brown or yellow color. The frequency of the passages depends upon the frequency of feeding. From the first, the infant will have several evacuations in the course of the twenty-four hours. This gradually changes, so that the usual rule is three or four passages in the twenty-four hours. After the period of dentition, and the child is fed on more solid food, the stools are more consistent, but should never be hard. During summer they are generally thinner, and always now have a more feculent odor, but are not really very offensive.

The urine is almost colorless, say of a light straw color, is passed very frequently, requiring frequent changes of its napkins, has a slightly urinous smell, and will average one or, at most, two ounces at a time. The bladder is quite small, and the child, having no consciousness as to any need of retaining it, will pass the contents of the bladder at the least provocation. This is gradually brought under control, perhaps, as much as anything, by the involuntary education of the child. Its sense of discomfort is very acute, and it soon observes, unless it is at once changed, that this discharge of the urine leaves it cold and wet. I am fully satisfied that instinctively the child is thus taught to retain the contents of the bladder, and thus, while not so frequent in the performance of the act, more fluid is discharged at each time.

The senses of a child become developed earlier than some imagine. A few days elapse and we find it no longer devoid of taste, but smell undoubtedly develops much later. Hearing, while not very acute, that is, so as to enable it to distinguish between special sounds, yet is sufficiently developed within the first few days that it becomes necessary to observe great caution as to the avoidance of noises within its particular sphere. The sense of hearing soon becomes quite acute, though its education does not progress with much rapidity until a much later period. Still, we soon find the infant able to determine between noises or sound of an agreeable or of a disturbing character. We constantly see illustrations of this, where the pleasant, endearing expressions of the mother will produce a cooing response from her infant; while an attempt, in no louder tones, on the part of a stranger will startle the little one, and it will show abundant signs of alarm and fear.

The sight is on a parallel with the sense of hearing. From the moment of birth, the eyes, which are open with an apparently inquiring look, will be turned to and from the light. Nor is it necessary for us to do more than observe the contraction of the brow when the face is exposed to a strong light, to understand that the optic nerve receives the impression, and that it is not an agreeable one. A short time elapses, and we find the little one following, with its eyes, its mother, as she passes near it, and soon it learns to distinguish her face from all others.

The breath should be inodorous, the tongue and mouth of a uniform dark pink color, and the lips of a bright red.

The infant is eminently susceptible of pain. In fact, its nervous system is particularly awake to all impressions, but,

fortunately, the sunshine and rain follow each other almost immediately, and we are led to believe that while acutely alive to unpleasant impressions, the effects are but transitory.

From this acuteness of nervous sensibility, we would readily infer that trifling irritations would induce, even in the healthiest infant, very grave forms of sympathetic affections, and thus produce dangerous morbid action.

Its cry, without tears, until the third or fourth month, expresses its feelings of hunger, of alarm, of pain, of anger, etc. These various causes of distress are at first expressed almost without any modulation, by the same shrill note, more or less prolonged, according to the cause. When from hunger, the act of suckling it at once appeases its cries. When from alarm or anger, even at a very early age, we can readily distinguish the difference. The first will cause it to break out afresh, again and again, amid the soothing caresses of its mother. The other is shown by the refusal to be comforted, and a turning from the breast as if in vexation. Pain, as it recurs at short intervals, causes the cries to break forth as in spasmodic efforts.

The attitude of the infant, whether awake or asleep, is perfectly natural, that of complete repose and helplessness. Unable, at first, to raise its head on its shoulders, it lies on the back, kicking its legs in every direction, beating the air aimlessly with its fists, which are almost constantly closed, but with the thumb out. Perpetual motion is the constant condition of the wide awake infant.

Thus it remains, with but slight changes or modifications, gradually unfolding its powers, strengthening its muscles, stiffening its bones, until the approach of the first dentition, or what are known as the temporary teeth. These are twenty in number, viz., four incisors, two canines, and four molars in each jaw. On an average, these teeth commence to appear at the age of seven to eight months; the two central incisors of the lower jaw being first, then the same of the upper jaw; the lateral incisors on either side are next, those of the upper jaw generally coming first, followed soon by the corresponding ones of the lower jaw. Leaving a gap, we next find the anterior molars of the under, and then of the upper jaw, about the end of the first year, or a month or two later. The canine teeth are much delayed, and are generally cut about the sixteenth to twentieth month. Lastly, the second posterior molars are cut generally by the middle of the third year. There is no reason why this period of dentition should be other than that of health, but unfortunately, the reverse obtains, and so bad a reputation has been acquired by the first teething that it is invariably regarded as a period of danger and trouble, and is always anticipated with much fear. I have seen many instances where the greater number of the temporary teeth were cut so readily that they almost escaped notice until their presence was detected by accident, as the biting of the nipple in the act of sucking.

The food now is more or less changed. Additions are gradually made to it in the shape of table food. Every form of light, easily digested material is advisable, and the breast milk becomes, as it were, a bonne bouche, or dessert; or is reserved for the night hours, and gradually the infant is weaned from its desire for the breast.

Articulation now begins, and proceeds more or less rapidly. From about the seventh month, efforts have been made at the formation of words, but these generally were merely mechanical, as when the infant, instinctively, as it were, would form the labial sounds, ma ma or pa pa, and would be encouraged to continue them by the pleasure evinced by those around it. Language is the result of the unfolding of the intellect. Words are increased as they become necessary to express the wants; hence the rapidity with which an infant learns to talk greatly depends upon its surroundings and its instructors.

Another power, that of locomotion, is now being acquired. As I have said before, we should neither retard nor hurry the infant in its efforts. At the second month we find it able to hold its head erect. In a few weeks more it becomes able to sit erect and tolerably firm. Thus it progresses, till we find it, by the seventh or eighth month, standing by chairs, etc., and in the tenth or twelfth month it moves off on its journey alone. There should be no dragging of the limbs or a bent back when a healthy child begins to walk, but it should be straight, with firm limbs. In fact, the act of walking should be evidently a pleasure, not a task.

Now it sleeps less, with less tendency to interruption during the night, as before, for the purpose of nursing. The child now generally goes to sleep with the dark and wakes with the light, until it is broken into other and less healthy habits.

The attitude in sleep is less important than when awake, as we constantly find infants placing themselves in apparently strained or uncouth positions, which we learn, on inquiry, are but a caricature of some habit of one or other of the parents.

The second dentition is less important, as it is rarely the source of much inconvenience.—*Med. and Surg. Reporter.*

MALARIA NOT OF VEGETABLE ORIGIN.

By John S. Hittell.

The purpose of this essay is to throw doubt upon the prevalent theory that malaria is a poison generated by the decay of vegetable matter. That theory, accepted on the authority of tradition and expressed in the name malaria (bad air), has come down from ancient times, but I do not know of any essay presenting a careful and comprehensive statement of the evidences in its favor. The only evidences known to me are nearly all negative in their character. They are, that malaria is confined to certain districts; that it is most common and most virulent in hot summers, in low moist grounds, where there is usually a luxuriant growth and a rapid decomposition of vegetable matter; that no explanation seemed so plausible as that of a poison formed by such decomposition; and that some explanation was needed in response to inquiry. The following are my reasons for asserting that malarious disease is not caused by a poison in the air:

1. A poison is a material substance of which chemistry can take cognizance, but that science knows nothing of any malarious poison, nor has any chemist ever pretended to bottle, much less to analyze it.

2. Various gases, including carbureted hydrogen, sulphureted hydrogen, and carbonic acid gas, are developed in vegetable decay, but they do not produce malarial disease in persons exposed to them in healthy districts under any combination of circumstances, though fruit and garden vegetables often putrefy with a rapidity and develop an amount of offensive gas much stronger in the restricted air circulation of houses than is observed in the most sickly malarious regions.

3. Malarial disease is not caused by the decay of animal matter, which contains the same materials as do vegetables generally, but bound together by a higher form of life, offering a more active resistance to the forces of inorganic chemistry, and therefore ready to separate with greater energy so soon as the laboratory of vital action loses control; yet the vicinity of a slaughter house, butcher shop, or market, no matter how unclean or fetid with the odor of putrefying meat and animal refuse, never causes malarial disease.

4. Malaria does not act like a poison. When arsenic or strychnine enters the stomach it combines with the tissues and prevents them from assimilating nutriment; malaria does not affect the system in that manner. We take antidotes for poisons and tonics for malaria, which is not known to pathology any more than to chemistry as a poison.

5. If malaria were caused by a parasitic growth, it would be communicated by exposure to it in the day as well as the night, and we should look for its symptoms in an inflammation of the mucous membranes of the digestive or respiratory organs, as we do in diphtheria or cholera; but malarial disease does not begin in that way.

6. If malaria were a poison developed by fermentation or putrefaction, it would be most dangerous in the day-time, but the observations in all the malarial districts for ages agree that there is very little risk of catching the disease in the day-time. The people who come to the insalubrious district in the morning and go away before sunset are secure. In many places the peasants spend the nights in the hills, though they work in the sickly valleys in the day-time.

7. The chief danger of attack arises from sleeping in a malarial district; and the attack comes sooner and is more virulent if the person sleeps in the open air, on or near the ground, or in a bedroom the window of which is left open; but we cannot explain the greater probability or severity of the attack under such circumstances on the theory of the existence of a malarial poison in the atmosphere. There should be as much poison in the air in a house as outside, and as much above the ground as near its level.

8. The virulence of malaria in districts bare of trees and in new countries, in ravines where there is no vegetation, in towns where the streets are being graded, in fortifications where ditches are being dug, and in tropical regions where railroads are being constructed, cannot be accounted for on the theory of an atmospheric poison arising from vegetable decay. The quantity of vegetable matter in the soil is too small and its decomposition is too slow to account for the fearful mortality that sometimes accompanies extensive disturbances of the ground.

9. Malaria is very troublesome in districts devoted to the cultivation of rice by irrigation, when the plants are in the most vigorous condition of growth, and when there is no decay.

10. A fire near the bed of a person sleeping in a malarial district has been found to be an excellent protection against attack, and it would not be if there was a poison in the atmosphere.

11. Dr. Pettenkofer, in an article republished in the *Popular Science Monthly* for February, 1878, and G. P. Marsh, in his book on "The Earth as Modified by Human Action," tell us that the composition of the atmosphere is about the same in an arid desert as in a forest, a swamp, or a greenhouse where there is a great quantity of foliage in proportion to the amount of air, and where the circulation of the air is prevented by the walls and roof of glass. The presence of one person does more to vitiate the air of a small, close room than would fifty large plants.

12. The limits of the malarial district are often sharply defined. A ridge ten or twenty feet above the general level of a sickly valley, and only two hundred yards wide, may be healthy, though there is no proof that the atmosphere there differs in the least from that all around it.

13. Malaria is much worse in low lands than in hills, though there may be the same quality and quantity of vegetation in the two regions, and a very short distance between them. Malaria is worse in the country than in towns, and worse in small towns than in large cities of high houses with thick walls of stone or brick.

We have been told of late years that the emanations of the leaves of the eucalyptus tree are an antidote for malaria. If these would prevent the disease there would be much reason to believe the existence of a poison. But there is a lack of proof that the eucalyptus has any peculiar virtue. It is cultivated extensively in California, and it has not put an end to malarial disease in the State or in any district of it. A statement was published that it had caused malaria to disappear on one farm in Kern county, but in the meantime years have elapsed and there is no authoritative confirmation of that report, and no evidence from other parts in California. We have reports that the eucalyptus groves have put an end to malarial disease in some districts of Algeria and Italy, but they are not conclusive. The report of the United States Commissioner of Agriculture, for March, 1876, says, though the eucalyptus plantations had grown very vigorously in the malarious district of Algeria, the cases of disease were as numerous as ever. I have no doubt, however, that in many places people may be protected against malaria by planting trees. Rank, in his "History of the Popes," tells us that part of the Campagna was not troubled with malarious fevers till Benedict XIV., in his avarice, cut down the trees that sheltered it. G. P. Marsh tells us that the annual mortality in the Maremma was reduced from 35,000 to 10,000 by various improvements, one of which was the planting of three or four rows of poplar trees on the windward side of every farm house. Becquerel observed that a screen of trees on the leeward of a marsh destroyed the miasma. In the vicinity of Sologne the marshes were free from fever till the trees were cut down, and when other trees grew the fevers disappeared. At Pisogne the people planted sunflowers to neutralize malaria, and Commodore Maury believed the inmates of the observatory at Washington were saved from malaria by sunflowers. In several cases groves have protected people against cholera which raged in adjacent plains. There are many reasons for believing that cholera is communicated by a poisonous parasitic growth (perhaps of a vegetable character) attacking the mucous membrane of the bowels; but it is not one of the malarious diseases, has little similarity to them, and nobody has advanced the idea that the protection against it afforded by forests is effected by a chemical neutralization of the poison.

While the facts of malarial disease cannot be explained on the theory of a poison in the atmosphere, they all harmonize with the theory that malarial disease is a chill following exposure to cold, caused by radiation or evaporation, or both. So soon as the sun goes down, in a hot season, under a clear sky, the heat of the earth, especially in level regions, is radiated out into space, with a great and rapid decline of temperature.

How do trees give protection against malaria or cholera? Perhaps by checking radiation or evaporation. The amount of evaporation from the soil of a forest clear of undergrowth is, as Pettenkofer informs us, only about one-third as large as in an open plain. The cold produced at night by evaporation from a moist soil is therefore considerably less in a forest. Again, the trees, by retaining the moisture in the surface of the earth and covering it as with a curtain, prevent it from becoming so warm in the day-time, and also arrest the radiation of its heat out into space at night. If malarious diseases are in any degree the direct result of change of the body's temperature, we can now see how their prevalence may be effected by trees. We can also understand the origin of the ideas common in malarial districts about the danger of sleeping on or near the ground, in the open air, in a low house, with an open window, on a bare plain, near ground freshly turned up, without a fire. These circumstances all harmonize with the temperature theory, and not one of them harmonizes with the chemical poison theory.

The thicker and higher the walls of the house, the closer the air heated in the day-time is kept to prevent the temperature inside from falling to a level with that outside, the higher the bed above the earth and the lowest stratum of air cooled by radiation and evaporation, the less danger there is for the inmate of the house in a sickly district. No place is troubled with malaria unless it is exposed to cold produced by active evaporation accompanied by radiation.

Aitken tells us that malarial poison is carried by the wind from its source in low ground up hill-sides to a height of 1,600 feet in Italy and 2,500 feet in the West Indies, and to a distance of 3,000 feet from the shore over the sea. Cold produced by radiation and evaporation might be carried in the same manner. It is well known that the hills are in many places warmer at night than the valleys, but in the line of air currents may have the same temperature.

It is supposed that the temperature of space in the universe beyond our atmosphere is about 300° Fahrenheit below zero, and so soon as the sun ceases to warm the earth by its rays after sunset the heat accumulated through the day rapidly radiates out into space. In Hindostan, a fall of 13° has been observed in less than five minutes. The speed of the radiation depends to a great extent upon the clearness of the atmosphere and sky. The less the proportion of moisture in the air the more active the radiation and the sooner after sunset the cold is felt. For this reason in dry subtropical and tropical countries the summer nights are much colder than in some lands farther north. Thus California, in latitude 35°, has colder nights than Missouri, 40°. In the desert of Sahara radiation sometimes causes the thermometer to fall to zero at night after standing at 100° in the afternoon.

Malarial disease is most abundant in those regions where the air is not clear, where radiation is not most active, and where the fall of the mercury at night is not most rapid. There is much malaria in certain swamps of the Sacramento valley, and very little on the dry plains ten to twenty miles distant. There is little malaria on the arid prairies in Wyoming Territory, and much in the moist bottom lands along the Missouri river, five hundred miles to the eastward. In general terms we may say that the drier the climate, and therefore the more rapid the radiation after sunset, the less the malaria.

Evaporation contributes with radiation to reduce the temperature of the earth after sunset. Wherever a breeze meets a surface moist with water, there evaporation follows and cold is developed. In a clear afternoon the surface of the earth is as hot as the air three feet above it; at night it is sometimes 20° colder. By exposing water in shallow porous pans, at night, the Hindoos get ice, when the atmosphere three feet above the pans has a temperature of 48°. Radiation and the evaporation of water together reduce the surface of the ground to 27° or 20° less than the air three feet above.

Malarial disease is most abundant and virulent where the ground and air are moist. Sometimes a district previously salubrious becomes malarious when the smooth, hard, and dry surface of the ground is dug or plowed up so as to expose a loose and moist soil with a rough surface to the air. Thus evaporation and radiation are increased and greater colds developed. The believers in the poison theory tell us that the soil, the disturbance of which causes fevers, is full of vegetable matter which decays on exposure to the air, but nobody has ascertained the amount of such matters before and after the sickly season, as compared with soils in other places. Chemistry would probably fail here, as in the atmosphere, to uncover any proof of poison.

I fancy, and probably until more evidence is obtained the ideas of the cause of malarial disease better deserve to be called fancies than opinions, that malarial disease is caused by the exposure of the body to cold for which it is not prepared. The man lies down to sleep in a sultry heat, without bed-clothes. The clouds and moisture in the air check radiation, and the oppressive heat continues far into the night. He goes to sleep; as the night advances, the cold increases, the dews fall, the atmosphere becomes clear, the clouds disappear, radiation is more active, and the body unprotected is thoroughly chilled, the pores of the skin close; the little blood vessels near the surface refuse to perform their functions properly, and the man is sick. In those districts where the climate is dry, the radiation is so rapid immediately after sunset that the night is cold before sleep begins, the man covers himself up, and there is less danger that he will suffer by a chill.

The radiation is less in hills than on the plain, and less from water than from moist land, and malarious diseases are rarer in hills and on water than on level land.

I have been told that malaria must be an atmospheric poison, because it sometimes does not break out until weeks after the person has left the sickly district; but I do not see the logical connection in this testimony. I suppose that the disease resulting from a chill might remain dormant in the human system as long as one from a chemical poison of which chemistry itself cannot tell us anything.

Dr. W. W. Hall, in his "Health at Home," a work which I quote without intending to condemn it for literary merit, medical learning, or sound reasoning, says: "An experiment has been tried, that if a barrel or two of the air of a miasmatic locality in the south is taken a thousand miles north and placed in a room where a man is sleeping, the room kept closed and of a southern temperature, fever and ague will be caused in a day or two."

I do not believe that such an experiment has ever been tried by a trustworthy observer with such a result. Hall's statement is bad in form. He asserts, not that any person was sickened, but that if the air from a malarious district be introduced into the room where a man is sleeping in a healthy district, "fever and ague will be caused in a day or two." This is not the language that should be used in reporting a scientific experiment. The question is not what will be the

result in a future trial, but what was it in the past? Hall's sentence conveys the idea that the malarious poison could affect none save sleepers. He fails to mention the place or time of this experiment, the name of the medical observer or of the patient, or of the book in which the original record may be found. It is, therefore, presumptively a fiction, a charlatan's trick. There is, however, one good feature about it: it suggests that experiments of this kind should be made. I, for one, would not be afraid to sleep in a room filled with the air taken from the most sickly swamp of South Carolina.

The best accounts that I have found of the circumstances under which malarial diseases occur are in the second volume of "Ziemsen's Cyclopedia," and in the books of Wood, Aitken, Flint, and Watson, on the "Practice of Medicine."

I got the idea of this article from a sentence in a book on "Physical Geography," by W. D. Cooley, who says: "In many cases the illness ascribed to malaria is, in truth, only a severe cold, caused by a sudden and excessive fall of temperature at sunset." That is all he has to say on the subject. In Reynolds' "System of Medicine" (vol. i., page 597) I find that he mentions, without accepting the theory, that intermittent fevers are caused by the suppression of "cutaneous secretions under sudden impressions of cold."

If the theory that malarious disease is caused by cold be true, and be accepted, it will have a great influence in reducing disease and suffering. In many districts there will be little difficulty in providing the substantial houses, with thick walls, surrounded by trees, with fires in the bedrooms high above the ground, needed to prevent a great decline of temperature at night and give security against the dreadful fevers. If malarial disease be caused by a chill, then it will probably be mainly attributable to a "suppression of the cutaneous secretions;" and it may be that scrubbing with the flesh brush—I prefer the one made of wire—and kneading the surface of the body—the most thorough system known is that practiced in the Hawaiian Islands, and there called *lomi-lomi*—would serve both as preventives and curatives.

The study of malaria is of special interest in California, where the climate is now, excepting in a small miasmatic area in the Sacramento-San Joaquin valley, extremely healthy, but where, unless some new light can be obtained, we must expect the extensive introduction of irrigation to be followed by the prevalence of virulent fevers.

I trust that I have said enough to raise doubts and provoke investigation. Many important questions connected with agriculture, as well as others of hygiene, are intimately associated with the changes made in the temperature of the surface of the earth by radiation and evaporation, and they deserve more study than they have yet received. I presume that the chief decline of temperature in hot and healthy climates is before and in unhealthy ones after 10 o'clock at night, or the common bedtime, and if that presumption were fully proved the fact would be entitled to much weight in the consideration of the cause of malarial disease. No comprehensive meteorological observations upon that point are known to me.—*Pacific Med. and Surg. Jour.*

DYSPEPSIA FROM IMPAIRED MOVEMENTS OF STOMACH.

AT a recent meeting of the Medical Society of London, Mr. Erasmus Wilson, President, in the chair, a paper was read by Dr. Leared on a neglected proximate cause of dyspepsia. He pointed out that all varieties of dyspepsia were referable to two divisions—atonic, and those depending on gastritis; the cause of the symptoms of functional dyspepsia being retarded conversion of food into chyme. There is a large class of cases in which digestible food, even in moderate quantity, is not digested with ease, and yet, in spite of much daily discomfort, the general health is hardly affected. The food is digested slowly, but effectually; there is no loss of flesh or strength; the appetite is unimpaired; and the defect cannot lie in the gastric juice. In by far the larger number of dyspeptic cases the lesion is not one of secretion, but of the proper movements of the stomach, which aid solution of food. Just as agitation of a glass containing water and crystals of a soluble salt will hasten the solution of the salts, so the attrition of the masses of food on one another by the action of the muscles of the stomach aids their digestion. Dr. Leared then described the arrangement of the muscular fibers of the stomach, and their action. In ordinary cases, whenever the contractile movements of the stomach are lessened, flatulent distention follows—due to lodgment of the food in the lowest parts of the stomach, and its fermentation there, and the distention of the viscus with the gases thus evolved, as well as probably from the small intestine. Flatulence, so common a symptom in such cases, acts harmfully by stretching the muscular fibers and impairing their tonicity. Dr. Leared, therefore, suggests that dyspepsia should be divided, not into atonic and inflammatory, but into "dyspepsia from impaired motion," and "dyspepsia from defects of secretion." In the former, uneasiness after meals, flatulence, and constipation are marked symptoms; in the latter, pains of sharp, shooting, dull, or dragging character predominate, the above symptoms being far less prominent, or even absent; indeed, from imperfect digestion of food in the cases due to deficient secretion, diarrhea may be set up by irritation of the intestines by undigested food. As to treatment, regulated diet was the chief measure, the principal meal to be taken early in the day before the nervous system has been exhausted by mental or bodily exertion. Strychnia, in the form of the tincture of nux vomica, is the most valuable drug for this condition, and should be administered freely. Although Chomel's condemnation of the drug has been indorsed by Brinton, strychnia has held its place as a remedy for dyspepsia. It should not be prescribed in pills, because of the difficulty of its exact subdivision, and the tendency of the alkaloid to precipitation by alkalies should be borne in mind. A dose of one-twentieth of a grain, given three times a day, should rarely be exceeded. The cases suitable for its employment required selection. Faradaism was not of much service; carbolic acid, or preferably, perhaps, thymol, checks flatulency by hindering fermentation; charcoal is of use in extreme flatulency for absorbing the excess of gases, the best form being that made from vegetable ivory. In a few obstinate cases passage of a long tube was necessary to relieve distention.

The PRESIDENT inquired of the author as to the time at which he would administer strychnine in flatulent dyspepsia. Exception should not be taken to this drug on account of its powerful action—a reason which had been urged against arsenic, a harmless drug when properly given.

Dr. THEODORE WILLIAMS used strychnia largely in dyspepsia, but he would not go so far as the author in saying it was the drug for flatulent dyspepsia, in which regulation of diet was of most importance. The atonic dyspepsia of women, with accumulation of fluid in the stomach, well described by Kussmaul, Dr. Williams would be inclined to treat by nutrient enemata, and so give the stomach functional rest.

Dr. THOROWGOOD agreed with Dr. Williams as to the importance of diet. In flatulent dyspepsia oppression due to over-distention rather than pain was complained of, and such cases were best treated by concentrated nourishment, more meat and less farinaceous food. In the irritative variety the treatment should be the reverse. Chomel records a case where pressure over the stomach forced fluid out of the mouth. Dry foods, and not medicine, alone availed in such cases.

Dr. JOHN BRUNTON had found benefit from strychnia. Ill-performed mastication was a prime cause of dyspepsia.

Dr. CRICHTON BROWNE would not be prepared to limit dyspepsia simply to impaired action of the muscular coat of the stomach, as there might be excessive action or irregular action. The secretion, besides being deficient in quantity, might be altered in quality. Strychnia, besides acting on the muscular coat, undoubtedly increased the secretion.

Dr. FOTHERGILL mentioned the dyspepsia of heart disease due to interference with the gastric circulation. The great bulk of the dyspepsia of women is a reflex form associated with menorrhagia and an irritable condition of the ovaries. Vomiting of pregnancy was an allied condition of such cases, which he found yield to blistering over the tender ovary, free purgation by sulphate of magnesia, and quieting the nervous system by bromide of potassium.

Dr. CORK advocated the use of iron in dyspepsia.

Dr. DE H. HALL asked whether the constant current was not preferable to the interrupted?

Dr. LEARED, in reply, stated that he gave one-twentieth of a grain of strychnine half an hour before meals three times a day, and often combined with iron. The discussion had not kept to the subject he wished to draw attention to—viz., the relaxed condition of the walls of the stomach. Diet was of the utmost importance, but most of all in the condition of gastritis. He agreed with Dr. Fothergill as to the occurrence of sympathetic dyspepsia, and thought the constant current of doubtful value.

RELATIONS OF SYPHILIS TO THE PUBLIC HEALTH.

PROFESSOR FRED. R. STURGIS, M.D., of the University of New York, has recently published a monograph on this subject, and from the wide range of experience of the writer, it becomes a matter of public importance to give full weight to his valuable report.

Without going into detail in regard to such cases in the army and marine, which in many instances show very disastrous results, as with the report of the mercantile marine of New York, where, out of 6,275 patients, the venereal cases amounted to 1,532, or over 24·34 of the total, let us, however, take the city of New York.

In the city of New York the total number of hospitals and dispensaries amount in round numbers to 46, where annually 280,536 patients are treated. From these institutions 11 were selected to serve as a basis for estimating the amount of venereal and syphilis in the city. Two months, January and August, were selected in 1873. In these hospitals the number of patients treated were 32,549, and of this number 1,458 were venereal, and the syphilitic 595. Expressing this in percentages, that of venereal to total number treated is 4·4, or 44 in every one thousand patients; that of syphilitic was 18 in every thousand, and that of syphilitics to total number of venereal cases is 41, or 410 syphilitics in every thousand venereal patients. If we now take the total number of poor persons who received gratuitous medical aid in New York city during 1873 as 280,556, and compute the percentage of venereal at 4·4, we find that in that city the indigent venereal amount to 12,341 persons, while out of that number 5,045 are cases of syphilis. But this takes no cognizance of private cases; these, by a process of reasoning and calculation based on statistics, are estimated to amount to 49,364 cases, of which 45,405 would be syphilitic. In other words, out of a population of 942,-291, sixty-one thousand seven hundred and five would be suffering from venereal diseases in some form, and of this 50,450 would be due to syphilis.

In London statistics showed that among the million and a half of poor population of that metropolis who received medical relief during one year, 7 per cent., or about one in fourteen, were affected with venereal diseases of some kind.

In Paris, where severe regulations are in force to control this disease, the returns are far from satisfactory, for by figures recently furnished by M. C. J. Lecour, Préfet of the French police, we find that the total number of venereal cases treated at the hospitals were 9,796. This includes, of course, no private cases. He then goes on to say: "We may consider these figures as one-fifth of the total number of venereal cases in Paris, who are treated at their homes by physicians, or who seek relief at the hands of apothecaries and charlatans. If this be so, we get a sum total of 48,980 cases, a formidable array, and one, probably, much below the real amount."

Space will not permit me to give other important statistics, and will briefly conclude with the general results of Professor Sturgis' close investigation of the subject.

1. Syphilis is widely spread, and possibly increasing in extent.

2. The question of fatality, so far as the acquired form of the disease goes, may be answered in the negative, but its excessive mortality in the congenital variety renders it serious and alarming. One cause of consolation remains, however, *i. e.*, that the disease does not probably extend to the third or fourth generation, usually dying out with the second, nor does it usually transmit any specially vitiated vitality to the later descendants of the original sufferer.

3. The danger to public health lies more in the transmitted disease than in the acquired, and whether this be permanent and dangerous, or only temporary and remediable, must be determined by future investigations.

Finally, the defective registration of this class of cases should be remedied. M.

MORTALITY IN THE PRINCIPAL CITIES OF THE WORLD.

THE German Imperial Statistic Office has lately published under this head some interesting particulars, from which we extract the mortality per 1,000 inhabitants in the thirty chief cities of the world (China excepted): San Francisco, 13·5; St. Louis, 14·8; Chicago, 18·0; Philadelphia, 18·3; London, 19·8; Edinburgh, 20·3; Basle, 20·9; Brussels, 21·0; Glasgow, 21·1; Rome, 21·2; Cologne, 21·3; Dresden, 21·5; Amsterdam, 21·8; Paris, 22·1; Copenhagen, 24·1; Vienna, 24·4; Liverpool, 26·4; New York, 26·5, Strasbourg, 27·3; Berlin, 26·6; Calcutta, 28·7; Hamburg, 28·8; Dublin, 29·0; Prague, 31·2; Lisbon, 32·8; St. Petersburg, 34·9; Bombay, 35·9; Munich, 37·2; Madras, 39·7; and Odessa, 48·3.

POISONOUS TIN PLATE.

ATTENTION has recently been called to a new risk of chronic poisoning by the old enemy, lead. What are called "tin" vessels—that is, sheet iron coated with tin—are in daily use in every household in the land. They are cheap, durable, and convenient, and have been considered perfectly safe for the thousand culinary purposes to which they are devoted. They *are* safe if the tin plate is honestly made; but unfortunately this is not always to be counted upon. Tin is comparatively cheap, but lead is cheaper; and an alloy of the two metals may be used in place of the dearer one, with profit to the manufacturer, though with serious detriment to the user. The alloy is readily acted upon by acids, and salts of lead are thus introduced into food. The Michigan State Board of Health has lately been investigating this subject, having been led to do so by a letter from a physician who found that certain cases of what had been taken for cholera were really *paralysis agitans*, which could be traced to this kind of lead poisoning. Other cases were brought to light in which children had died of meningitis, fits, and paralytic affections, caused by milk kept in such vessels, the acid in the fluid having dissolved the lead. Malic, citric, and other fruit acids are of course quicker and more energetic in their action upon the pernicious alloy. The danger is the greater, because the lead salts are *cumulative* poisons. The effect of one or two small doses may not be perceptible, but infinitesimal doses, constantly repeated, will in the end prove injurious, if not fatal.

Analysis of a large number of specimens of tin plate used in culinary articles, says the Boston *Journal of Chemistry* in reciting these rather alarming facts, showed the presence of an alloy with lead in almost every instance, and often in large quantities. It is safe to assert that a large proportion of the tinned wares in the market are unfit for use on this account.

That it might not be accused of exciting groundless fears, the *Journal* goes on to show how any one can settle the question by a simple and easy test. Put a drop of strong nitric acid on the suspected "tin," and rub it over a space as large as a dime. Warm it very gently till it is dry, and then let fall two drops of a solution of iodide of potassium on the spot. If lead is present it will be shown by a bright yellow cover, due to the formation of iodide of lead.

It is stated by Dr. Kedzie that a peculiar kind of tin plate, the coating of which is largely made up of lead, is coming into general use for roofing, eaves-troughs, and conductors; and it is suggested that much of this lead will eventually be dissolved and find its way into household cisterns. Susceptible persons may be poisoned by washing in the lead-charged water, and all who drink it, even after it is filtered, are in danger of chronic lead poisoning.

In view of the large and increasing importance of our canned-food trade, our manufacturers should see the absolute necessity, commercial as well as prudential, in vigorously excluding the use of tins open to suspicion. The temptation to use the cheaper metal may be great, but to yield to it would do more to destroy the trade in canned goods, and the industries depending on it, than any other influence that we know.

SUICIDE IN FRANCE.

Les Mondes presents an abstract of a recent statistical study of suicide in France, by Dr. Eugene Moret, from which we gather the following facts:

A preliminary table exhibits the increase of self-murder from 1831 to 1875. During these 45 years there were 173,232 suicides. Every quinquennial is marked by an increase in the number. The annual average, which during the period from 1831 to 1835 was 3,317, reaches the figure 6,107 during that from 1871 to 1875. These statistics are still more appalling, if we calculate the annual average number of suicides per 100,000 inhabitants. Discarding fractions, the number of suicides is 6 for the first quinquennial period (1831 to 1836), 7 for the second, 8 for the third, and thus successively up to 1865-1870, when it reaches 13. The last period (1871-1875), reaches at one jump the enormous figure of 168, or nearly 17 suicides per 100,000 individuals. This result is partially explained by the events of which France has been the theater. After a war, suicide and crime increase largely in every country. Next in order after political commotions, age appears to be one of the causes which has most influence on suicide. Suicides increase regularly with age, and the maximum is found among individuals of 70 to 80 years. Toward the decline of life, especially during the present times, it becomes difficult to support existence, so it becomes an easy matter to explain the results furnished by the statistics. It is a more difficult matter to understand the increase of suicide among children less than 16 years of age. This is a point to which Dr. Moret calls particular attention, and which is well discussed in his paper. The author afterward shows that suicides are four times less frequent among women than among men, and, in throwing out the two extreme seasons, winter and summer (which act almost in the same way on the two sexes), it is found that suicides among men are most frequent in spring, while those among women take place oftenest in fall. As to the influence of the civil state, it is proved that suicide among married men are twice less than among bachelors, and three times less than among widowers. As regards women, it is found that the married and unmarried commit suicide with about equal frequency, while the number is double for widows. Suicides take place less frequently in the country than in the city, and Paris is the city which can reckon the largest number of self-murders. As to the methods chosen for suicide, it may be said that nine-tenths take place by hanging, drowning, firearms, and smothering by charcoal. The remaining tenth is accomplished with sharp instruments, poison, jumping from elevations, etc.

GLYCERINE CEMENT.

THE *Répertoire de Pharmacie* gives a formula for a glycerine cement suitable for cementing all sorts of metals, even in the form of pumps and steam boilers, as it can withstand the action of a temperature of 275° C. It may also be used as type for galvanoplastic purposes, as it reproduces with fidelity and delicacy the surface of the copy, and is easily made a good conductor. Before the application of the cement the parts that are intended to be dense should be carefully cleaned and coated with dilute glycerine. The cement, as it comes into the market, is made simply by mixing glycerine with the greatest care with washed and sharply-

dried litharge, in such proportions as to form—according to the purposes for which it is required—either a stiff paste or a thickish liquid, which quickly hardens into a homogeneous mass.

CAUSTIC ALCOHOL.

(SODIUM ALCOHOL AND POTASSIUM ALCOHOL.)

By ALBERT B. PRESCOTT, M.D., Professor of Organic and Applied Chemistry and Pharmacy, University of Michigan.

THE attention of the medical profession is just now asked to the claims of a new caustic, another one of that category of organic chemicals which have been from time to time brought forth from the musty records of pure science into the well-ventilated world of every-day use. As soon as the idea is mentioned it is very easy to see that sodium alcohol, or sodium ethylate, possesses certain striking physiological relations to the tissues, giving it novel claims to consideration as a caustic. Whether a more extended trial shall show that the peculiar action of this substance on the tissues gives it a decided value for some given use of a caustic, or even for any use of a caustic, it would, of course, be premature to assert. Though practically new, it does not really bring upon the tissue a new caustic; it merely offers a new means of applying an old and well-known caustic; doing this so that the application controls and regulates itself.

Dr. B. W. Richardson, of London, who introduced nitrite of amyl, amyl hydride, and other anæsthetics, and is known for more important work, first published the use of "caustic alcohol" in 1870, and has lately explained his use of the article more at length, owing to reports of decided success in its use by Dr. Brunton, and to some discussion of the matter in pharmaceutical circles, in the present first public attention to the subject.

The formation, chemical structure, and the theory of the action of caustic alcohol may be explained as follows: It is well enough known that when sodium (or potassium) is dropped into *water* that the metal displaces half the hydrogen of the water, which displaced hydrogen escapes as a gas, with effervescence, while sodium (or potassium) hydrate remains. This hydrate is, of course, an oxide of sodium and hydrogen, and is ordinary caustic soda. Now, when sodium (or potassium) is dropped into absolute alcohol, hydrogen effervesces away, and an oxide of ethyl and hydrogen remains, this being sodium alcohol (sodium ethylate), "caustic alcohol." Avoiding symbols, as but little more compact than words, the chemical structure of the compounds in question may be presented as follows:

Water.	Caustic Soda.	Caustic Potassa.
Hydrogen, Hydroger, } Oxide.	Sodium, Hydrogen, } Oxide.	Potassium, Hydrogen, } Oxide.
Alcohol.	**Sodium Alcohol.**	**Potassium Alcohol.**
Ethyl, Hydrogen, } Oxide.	Ethyl, Sodium, } Oxide.	Ethyl, Potassium, } Oxide.

Sodium and potassium alcohols are very deliquescent solids, crystallizable, but melting at slight elevations of temperature. They are very different substances from mere alcohol solutions of caustic soda and potassa.

As sodium alcohol is better for use and much cheaper than potassium alcohol, only the former of these two analogous compounds will be now mentioned.

On contact with water sodium alcohol is resolved into sodium hydrate (caustic soda) and ethyl hydrate (alcohol). And this occurs, Dr. Richardson says, when the sodium alcohol is brought in contact with the tissues, and it is the produced sodium hydrate, common caustic soda, that actually does the work as a caustic. This is an old-fashioned caustic, caustic potassa more often taken, and, when not held in check, little deserving favor. *It is held in check*, in the use of sodium alcohol (1) by its *limited production*, from the restricted quantity of water in the tissues; (2) by the extreme *drying* of the tissues as dehydrated by the water used up in making the dry caustic soda and the anhydrous alcohol. Also, Dr. Richardson states (3) the absolute alcohol *coagulates* the tissue decomposition products, barring the spread of the caustic; and (4) the dead organic substances are *preserved* from further decomposition by the alcohol.

To completely stop the action of the caustic in the tissues it is only necessary, after removing the applied sodium alcohol, to add *chloroform* to the part, when all remaining sodium alcohol, and to some extent, also, the sodium hydrate, are extinguished (so to speak), by formation of sodium chloride and certain ethers.

The sodium alcohol is diluted, according to the end to attain, *with absolute alcohol*, and "can be used so as to cut like a knife," or so as to serve as a mild caustic, little more than a very sharp stimulant. Dr. Richardson places one part of the sodium alcohol to one and a half parts of the absolute alcohol, as the strongest caustic safe against causing hemorrhage, for vascular parts.

The preparation will dissolve opium and nearly all substances soluble in alcohol.

Dr. Brunton applied the new caustic to nævi, with marked success. Dr. Richardson states that he has used it in cases of bites of dogs, would recommend it in bites of serpents, uses it in many instances needing a caustic, and awaits further experience as to its adaptations.

It may again be remarked that no positive opinion of its real value, compared with other coagulating caustics, is ventured upon, in this presentation of the unique claims which this agent makes for itself, by virtue of its chemistry. Indeed, how far ordinary deliquescent caustic alkali becomes a constringing and coagulating caustic in the form of our "caustic alcohol," remains to be proven.

It is applied best by means of a pointed glass rod, or pointed prolongation of the glass stopper of a bottle to keep it in; next best, by a quill pen, freshly cut each time used. Glass brushes are apt to break off.

It can readily be prepared, by any pharmacist, with due care, provided only that absolute alcohol and metallic sodium are at hand. The alcohol must be very nearly or quite absolute, specific gravity not over 0·795. If the alcohol contains water, this water will simply form sodium hydrate, which will dissolve in the alcohol. The mixture soon turns brown, and there is little or no check to its action on the tissues. If diluted with alcohol not absolute, the water therein will decompose the sodium alcohol. It is not very laborious to make absolute alcohol from the ordinary, by distillation from quicklime, but that is too long a story for this occasion. Sodium is comparatively cheap now, about one-sixth the cost of potassium. The following are Dr. Richardson's directions, in substance:

Take one-half fluid ounce of absolute alcohol in a two-ounce test-tube. Set in a water bath at 50° F. Add, gradually, small cuttings of clean metallic sodium until hydrogen gas ceases to escape. Then raise the temperature to 100° F., and a little more sodium, or until the gas again ceases to rise, stopping to add if crystallization occurs. Cool to 50° F. (The preparation thickens.) Add one-half fluid ounce of absolute alcohol (for the strongest caustic to apply, or more, as needed for the use desired). Two parts of absolute alcohol will require one part of pure sodium to make the absolute sodium alcohol.—*New Preparations.*

ARTIFICIAL COLORING MATTERS.

THE firm of P. Monnet & Co. of La Plaine, Geneva, have issued a report descriptive of the colors which they manufacture. Their scarlet and hortensia are derivatives of fluoresceine, in which bromine and hyponitric acid are jointly substituted. The scarlet is chiefly used in wool dyeing, while hortensia is applicable not merely to wool and silk, but to cotton. These colors are evidently closely connected with the "saffrosin" of Bindschedler & Busch, described in our last. Pyrosine I is pure biniodfluoresceine, and Pyrosine R is a mixture of bi and tetraiodfluoresceine. Both are described as dyeing a fine ponceau shade, though tetraiodfluoresceine alone gives a color tending more to the violet. Our readers will remember that the "blue eosine, soluble in water," of Bindschedler & Busch, is the soda salt of this same tetraiodfluoresceine.

The Rose Bengale, phloxine, and cyanosine of Monnet & Co. are rose colored dyes, brome and iod derivatives of fluoresceine. The first mentioned was discovered in 1876 by Nölting. Since the beginning of 1877, Monnet & Co. sell the soda salt of benzyl fluoresceine under the name of chrysolin. It is soluble in water, and gives a fine yellow color upon tissues. It was discovered by Reverdin, chemist to the above firm, and is produced by the action of phthalic and sulphuric acids upon a mixture of chlorbenzyl and resorcine. Cotton is prepared to receive the resorcine colors by being mordanted in an alum beck previously neutralized by the careful addition of soda, and then in emulsive oil, as used for Turkey reds. Acetate of alumina gives, however, the best results.—*Chemical Review.*

DYES FOR WOOL TO STAND MILLING.

Dark Gray.—Boil for 90 minutes in a water containing—

Extract of sumac	2 per cent.
" " logwood	1 " "
Copperas	2 "

For lighter shades reduce ware in proportion.

Silver Gray.—Boil for an hour in a water with—

Extract of sumac	2 per cent.
Logwood	1 " "
Soluble iodine violet	1/8 " "
Copperas	1 " "

Olive.—Boil for an hour with—

Fustic	50 per cent.
Bluestone	5 " "
Argol	2 " "
Sanders	2 " "
Copperas	1 " "

Bright Olive.—Boil for an hour with—

Fustic	50 per cent.
Bluestone	5 " "
Argol	2 " "
Copperas	1 " "

Extract of indigo, acid, as may be required.

NEW BLUE ON FLANNEL.

Red prussiate	8 per cent.
Sulphuric acid	8 " "

Enter at a hand heat and raise gradually to a boil, which is kept up for half an hour, and cool. Take out and add to the beck a strained solution of about 1/4 per cent. of the new "acid magenta," and the same weight of salt of tin, and dye for another half hour.

It is well before adding the magenta to take out a part of the flot, and make up with cold water. If several successive lots are to be dyed in the same bath the proportion of sulphuric acid and of magenta may be lessened after the first lot.

SOLID SHADES FOR WOOL.

Ash Gray.—Boil for 90 minutes with 4 per cent. of gallnuts, 2 of sumac, 4 of logwood, 3 of copperas, diminishing the proportion of the ware for light shades.

Mode Gray.—Boil for the same length of time with 3 per cent. of gallnuts, 1 logwood, 4 orchil, 1/8 soluble iodine violet, and 1 copperas.

Olive.—Boil as above with 50 per cent. of fustic or 15 extract of fustic, 5 logwood, 4 bluestone, 4 argol, 3 orchil, and 1 copperas.

Jet Black.—Boil for 90 minutes with 2½ per cent. of bichrome and 2 of sulphuric acid. Lift, spread out, and let lie till quite cold, and dye in a second water with 40 per cent. of logwood, 8 fustic, and 1½ bluestone. After boiling for an hour, wash and dry.

Blue Black.—Prepare as above with 2½ per cent of bichrome and 2 per cent. sulphuric acid. Then boil for the same length of time in a second water with 40 per cent. of logwood and 1½ per cent. bluestone. Wash and dry.

Bright Blue.—Prepare as above with 3 per cent. of bichrome, 2 per cent. sulphuric acid, and 2 per cent. alum. Dye in a second water with 25 per cent. logwood, and the solution of 1/4 soluble aniline violet. Wash and dry.

Reddish Brown.—Boil for 90 minutes with 3 per cent. of bichrome and 2 per cent. sulphuric acid. Let cool in the flot, and enter in a cold water made up of 30 per cent. of peachwood, 5 per cent. of fustic, and 1/4 of alizarine orchil. Raise to a boil, and keep it up for half an hour.—*Teinturier Pratique.*

BLASTING GELATINE.

A NEW and powerful explosive, discovered by Nobel, and pronounced by the Austrian military authorities to be highly suitable for military purposes, promises to be very useful in the arts of peace. This substance, called "Blasting Gelatine," is formed by dissolving collodion of cotton in nitro-glycerine in the proportion of 10 per cent. of the former to 90 per cent. of the latter. The result of the solution is a gelatinous, elastic, transparent, pale-yellow substance, having a density of 1/2, and a consistency of stiff jelly.

The new explosive is in itself much less easily affected by blows than ordinary dynamite, but it may be rendered far more insensible to mechanical impulse by an admixture of a small proportion (from 4 to 10 per cent.) of camphor. Experiments have been carried out, the result of which is to prove that the new explosive possesses, weight for weight, 25 per cent., and bulk for bulk, 40 per cent. more explosive power than ordinary dynamite. With moist gun-cotton, gelatine compares nearly as favorably. The temperature at which it explodes is about 204° C., when heated gently, and 240° C. when heated suddenly. The addition of camphor, however, seems to raise this point to 300° to 330° C.

Water has little or no effect upon this substance; it may be burned in considerable quantities without any fear of explosion, and it is as stable and durable as either dynamite or gun-cotton. The cost of production of the new article is half as much again as dynamite, and about the same as that of compressed gun-cotton.

THE ORIGIN OF TEMPORARY AND VARIABLE STARS.

[From the Christ Church (New Zealand) *Press.*]

THE following paper was read by Professor Bickerton, at the meeting of the Canterbury Philosophical Institute, New Zealand, on Thursday, July 4th:

The sudden appearance of stars in various regions of the sky have been recorded from very early dates. Some of these stars have had an intensity of light greater than any of the fixed stars, and in some cases have remained visible for a year or more, the intensity of light all the while gradually diminishing.

Two considerable stars of this kind have appeared within the last twelve years, and in both cases they have been examined with the spectroscope. Unfortunately the results have not been so satisfactory as could be desired. The spectrum of the star of 1866 appears to have been continuous, with bright lines. The lines diminished in number and intensity until they finally disappeared, leaving only a feeble continuous spectrum. The light of the star of 1877 at first appeared yellowish, and when five or six days afterwards it was examined with the spectroscope, a line spectrum was seen. The number of lines gradually lessened until only one was left, and that the same line as seen in some nebulæ.

A few considerations will show the stupendous nature of these phenomena. Temporary stars have all appeared to be fixed in the heavens, this fact showing them to be at true stellar distances, and consequently, like the fixed stars, their luminosity is comparable to our sun. The sun may be roughly classed as a star of the second magnitude; its intensity is approximately 1-400th that of Sirius, which is a very short distance from us relatively to the size of our universe, therefore it is not improbable that these temporary stars should be on an average at least as far away as he is.

We may therefore safely assume that most of the temporary stars whose appearance has been recorded, have had an intensity of light as great as the sun, and probably in some cases many times greater, and the amount of heat radiated from each square yard of our sun's surface is estimated to be equal to the combustion of ten cubic yards of coal in every hour, whilst the sun's disk has four times the area inclosed by the orbit of the moon. The star of 1866 when first seen was of the second magnitude, and its spectrum shows that it consisted of a nucleus of compressed gas, or of liquid or of solid matter. This was surrounded by an atmosphere of heated gas, having a greater monochromatic light than the nucleus, or it might have been simply a small permanent star in the same line of vision as the gaseous temporary star. I cannot say if this suggestion agrees with the present condition of the star. This star diminished from a star of the second magnitude to the tenth in about a fortnight. The spectroscope showed the star of 1877 to be ignited gas only, and from the number of the lines diminishing the temperature and pressure probably did so likewise. The intensity diminished in four months from the third magnitude to the ninth.

Many hypotheses have been formed to account for the nature of these stars, of which the following appears to be the most noteworthy:

1. Zöllner imagines a sun in which spots have covered the whole surface, the temporary stars being produced by the breaking up of such a surface.

2. Vogel assumes a volcanic bursting out on a dead sun.

In both of these hypotheses a decomposition and combustion of hydrogen and other elements is also assumed to account for the great intensity.

3. Meyer and Klein suppose that a similar dark body is suddenly raised to incandescence by the projection of a planet or other body upon its surface.

4. Proctor supposes that the atmosphere of a dead sun is suddenly brought to a high degree of luminosity by the passage of a meteoric train through it.

In examining these hypotheses, we find that there is one thing in common, namely, the assumption of the existence of large dark bodies in space. The first two of them also depend on the existence of internal commotion, attended with combustion. The last two depend upon the energy developed by gravitation.

A little consideration will be sufficient to show that on grounds of intensity alone, Zöllner's and Vogel's, in fact, any hypothesis not dependent upon gravitation, is improbable. Is it conceivable that a dark body should suddenly change its surface by volcanic or other internal action in such a manner as to heat gases to a pitch of luminosity as high as our sun's, especially when it is considered that if a gas and solid be at the same temperature, the solid is much the more luminous of the two; nor would combustion or decomposition help it; generally the latter would take place, but would tend to diminish rather than increase the intensity. How inadequate combustion would be is shown by the fact that a pound weight would develop about forty million units of heat in falling upon the sun, and the combustion of a pound of mixed oxygen and hydrogen would only develop about 4,000 units. And again, in either case the chief luminosity must be from the fused material; a continuous spectrum would then result, which in the last star at least is altogether contrary to observation. The precipitation of a body upon the surface of a dead sun is much more probable; so likewise is the meteoric theory; but in the former case if sufficient heat could be developed a fused mass would almost certainly result, and in the latter case nothing short of a marvelous combination would prevent its resulting. The latter hypothesis Proctor bases on the bright momentary light once observed on the face of the sun; he assumes that the gaseous photosphere was temporarily raised to a high luminosity by meteors. I think this of itself is very improbable. I cannot conceive how it is possible that if the atmosphere were raised to incandescence it could cool again in so short a time as two minutes. I think it far more probable that that most wonderful phenomenon (affecting as it did the entire earth)

was due to the collision of two bodies revolving in approximately opposite directions around the sun. Such a pair of bodies would have their temperature raised to about one hundred million degrees Centigrade. I need not say that such a temperature would quickly volatilize such small bodies and produce an intense light; the phenomenon is in this way explained without any assumption other than known laws. The basis of the meteoric hypothesis is thus shown to be in the highest degree improbable, and even if it were admitted it would require an inconceivable number of masses to raise the atmosphere of a dark body to such a temperature as to produce a luminosity as great as our sun's and of some months' duration. Still more inconceivable does it appear that the body upon which they impinge should only have its atmosphere raised to such a luminosity, while the body itself remained non-luminous. Altogether the theory of Meyer and Klein appears the only possible one, but it is only when both bodies are of such stupendous dimensions as to produce complete volatilization that the hypothesis agrees with spectroscopic observation; and such a case does not appear to be contemplated by the authors or they would scarcely have suggested a planet. Nor could complete dissipation take place by the entire coalescence of two bodies, however large, unless they had a higher initial velocity than observations of the proper motion of stars render probable. No one of these hypotheses, therefore, appears to be a satisfactory explanation of the phenomenon.

An hypothesis that agrees better with observation would be one of partial impact. If two immense bodies moving in space come well within the influence of each other's gravitation, they would be attracted out of their path with a constantly increasing velocity. Three possibilities present themselves—the first, the most general one, of passing each other and ultimately attaining their original velocity in space; the second would be that of imperfect impact; and, third, as an extreme case, we should have complete impact when the center of each mass would have, except for the collision, occupied the same point at the same time. It is reasonable to assume that in impact the case of partial collision would be more probable than complete impact. And it is this imperfect impact that is the basis of the present hypothesis. In this case a piece will be struck off each colliding body; these two pieces would to a greater or less degree coalesce, developing at the same time a high degree of heat, while the remainder of the two bodies would pass on and ultimately attain approximately the same velocity in space. This case appears competent to explain the occurrence of temporary, double, and variable stars, nebulæ of various kinds (the kind depending on the nature of the impact), comets, and finally stars or suns accompanied by bodies of smaller size. The third case, that of complete coalescence, is probable only in the collision of very large bodies, and offers an explanation of the existence of large spherical nebulæ with a general condensation towards the center. (We will consider the hypotheses somewhat in detail.) In order to render the conception of the hypothesis as simple as possible, I shall all through keep as far as I can to a direct conception of energy, as in this way most questions may be reduced to ordinary arithmetical series. Thus, if the two approaching bodies be equal to each other (at the same distance), the attracting force acting on each unit of mass will be proportional to the total mass of either; now in a force acting through space, the work equals the force multiplied by the space through which it acts, and the work is equal to the heat.

The sun, by attracting a body from infinite space, would give it a velocity of 378 miles a second, or each unit of mass would develop about forty million units of heat. If we suppose two bodies, each half the size of the sun, to come together by mutual attraction alone, then each unit of mass would develop about twenty million units of heat. If, on the other hand, two bodies twice the mass of the sun come together, each unit of mass would have four times the force acting upon it through equal spaces, and each unit of mass would consequently develop four times as much heat. If the impact of such bodies were imperfect, as we have seen the general case would be, a piece of each would be cut off, and these two pieces would coalesce. Suppose a quarter of each be struck off, a body of the mass of the sun would be produced, but it would have four times the temperature the sun would have, assuming the sun to have been formed by direct impact and complete coalescence. Each unit of mass in this case would have approximately eighty million units of heat; and the temperature will depend upon the specific heat of the material, and may be much higher than this.

I will now show, in the case of partial collision, how small relatively the work of cutting off the piece is compared to the energy available. It appears to me that in all cases the energy needed for shearing force has its superior limit in the latent heat of fusion. This, in the case of ice, is about one-fiftieth that of combustion, and combustion is about one-twenty thousandth part that of percussion, in the case we have been considering. The work of shearing would consequently not be greater than one-millionth that of the energy of velocity, and so it appears it may safely be disregarded. Thus in the case of such a partial collision it may certainly be accepted that those parts not in the line of motion of the other body will not coalesce with the other body, but will pass on in space. In the piece struck off we shall have partial destruction of motion in space, with development of heat; many pieces will fly off, and a rotary motion of the whole will ensue. There will be a slight pause from inertia, then the powerful outward pressure due to the expansion by heat will overcome all resistance, and will expand the whole into gas, much of it certainly passing beyond the limits of effective attraction, and away into distant space. Let us pause for an instant to examine a little more fully what has happened. Two pieces of different bodies, each with a velocity of about 500 miles a second, have coalesced, but although the motion of translation is destroyed the larger part of each side of the mass is made up chiefly of one of the two different bodies; as these are moving in opposite directions, there is consequently a couple acting on the mass, and this couple spins the mass on its center. Consequently many pieces fly off, and are followed by the mass of gas, being impelled outward by the energy of heat and centrifugal force. While on the other hand we have inertia and gravity tending to keep the mass together. The centriful force acts only in one plane, while the repellent force of heat acts in every plane; a bun-shaped mass must result, with a number of distinct pieces, which at first at least are in advance of the general mass. Follow it on in time and we get the ring nebula, with or without a luminous center; in the latter case, with a dark circle dividing those parts whose velocity has carried them beyond the powers of the attractive force, from those parts held prisoner by it. These parts as they gradually radiate heat into space, are once more slowly attracted to the center by gravitation. If the piece struck off from each body were very small then complete dissipation of the whole would result. Clearly such collisions as I have described would be competent to produce every variety of temporary stars that has appeared. Applying the spectroscope to such a star, we get at first a continuous spectrum; then black lines, quickly followed by bright lines and spectrum; then bright lines alone. Again, if the colliding bodies were of very different size, or if the heat were not great enough to entirely volatilize the star, we should have lines and spectrum. Lastly, as heat and pressure diminish by the dissipation of the body into space, we get fewer and fewer lines, until only those substances in greatest quantity, or of greatest power in giving lines at lowest temperature and pressure, remain luminous, and we have a nebula left; or in the case of total dissipation of the gaseous mass all evidence of its existence will disappear. It will be seen how exactly the above hypothesis agrees with the spectroscopic observation of temporary stars, and I have shown as fully as perhaps it is wise to do in this paper, that the hypothesis of partial impact is competent to account for every variety of these bodies, and also for their intensity and short duration. We must now return to the parent bodies which we left traveling on in space. A cylindrical or curved slice has been cut out of each; sometimes that is the chief thing that will happen. But on the other hand we may have the molten interior of the body exposed to view. If there were atmospheres on the two colliding bodies, a very great heating of the surface of the section would result, and when both causes are acting in unison a stupendous lake of fire must be formed. Let such a body rotate on its axis alternately, the light and dark sides are shown, and we get a variable star. May not Mira in this way be attempting to tell us her autobiography—how she is a dark body with a molten lake of fire, 30 degrees of arc, a lake as big as our sun, and how she rotates about an axis in a little less than a year? If it be so, she tells us of a dark body almost as large as Sirius, or how would 30 degrees of arc produce a star of the first magnitude? Algol appears to tell us that it is a dark and gloomy parent with a brilliant son who periodically passes partly behind his dusky parent's body, and in this way suffers partial eclipse.

But the autobiographies of these bodies must not detain us; we must discuss the existence of such gigantic feebly-luminous or non-luminous bodies as our hypothesis demands. The existence of variable stars seems sufficient to prove there are such bodies, and, as I have shown, all the hypotheses offered in explanation of temporary stars assume their existence. The high temperature and small relative light of celestial radiation points to the same conclusion, or to non-luminous gas. It might be asked, if there are dark bodies why not stellar eclipse? I do not know if such have been observed; it would be wonderful if any had been, for they must be very rare, probably as rare as temporary stars; for, although we have all the depths of space in which eclipses are possible, on the other hand, with temporary stars we have attraction bringing very distant bodies together. Further, the points of light of the fixed stars form but a small area in space, and, lastly, if eclipses occurred they would probably not be recorded, as small black patches of cloud so often obscure a portion of the sky that such an occurrence would scarcely attract attention. But why should there not be large dark bodies? Laplace's theory of a universal nebula may be assumed to be against it; but did Laplace assume that it was contemporaneous? if not then even that theory does not interfere. All our conceptions seem to agree more with a rhythmic cycle than with any definite beginning or end. If we assume this hypothesis, then the period of dissipation of energy seems indefinitely projected into futurity; for all radiation falling on the matter in space, must prevent its temperature from falling so low as without this radiation, and when at a subsequent date a collision occurs, this heat must exalt the final temperature, nor does it appear that we need look forward to a gigantic dead sun as the final condition of this universe; for doubtless our universe has its own proper motion in space, which may bring us into collision with other universes. This shows gravitation to be as competent to multiply worlds as to absorb them one into another. But after all, our hypothesis only takes us a step further back in time, and our imaginations a step further forward into the future, thus removing further than ever from our conceptions every trace of a beginning or promise of an end.

THE LIGHT FROM VENUS AND MERCURY.

A CURIOUS discovery has just been made by Mr. James Nasmyth, the learned English astronomer, concerning the light of Venus and Mercury. It remains to be seen whether photography or spectrum analysis will some day give us the key to the enigma. The fact is that there is a great difference between the degrees of brilliancy emitted by these two planets; and, that while Mercury being much nearer the sun should be more brilliant, just the contrary happens, for Venus shines with the greater luster. On the 26th and 27th of September these two stars were near enough to be embraced within the field of the lens at the same time, and Mr. Nasmyth was thus enabled to compare the brilliancy of Venus to polished silver, and that of Mercury to lead or zinc. The reason of this difference, which is theoretically exactly contrary to what we should expect, is at present unexplainable.

THE CHINESE ALMANAC.

PROF. HARRINGTON, who has evidently studied the Chinese official almanac, in its original tongue, gives in *Silliman's Journal* some very interesting information in regard to the contents of this curious document, so highly important to about one-third of the human race. This almanac is issued annually in December, being carefully prepared by an imperially-appointed board of astronomy; it is highly respected by the Chinese, and may be considered as the representative of the highest state of astronomical science reached by them. The book consists of two parts—the astronomical and the astrological—the latter taking up the greater portion. On examining the astronomical part we discover that no mention is made of eclipses, these being usually computed and published just before they occur, and the computations, as well known to foreigners, are very often as much as an hour in error. The times of sunrise and sunset are given for 48 days in the Chinese year. The dates are from 3 to 15 days apart, and the intervals are shortest when the sun is changing his declination most rapidly. The times of rising and setting are arranged very symmetrically, and the same hours are repeated from year to year. As it is the hour of rising and setting that is repeated, and as the Chinese month is the lunar one, the dates are changed each year. No corrections whatever are given in the table of the rising and setting of the sun, the Chinese, in common with most oriental nations, disregarding the equation of time. This custom has its origin in the use of sun-dials, and is natural when the use of timekeepers is not common. The times of the moon's quarters and of the 24 Chinese seasons are also given, and as they are given to the minute, it is fair to assume that they are offered as correct. But corrections in the calculations of the moon's motions can scarcely be expected of a board which cannot compute the time of sunrise accurately. An examination of the Chinese publications for two years shows that the range of error is from 15 minutes fast to 26 minutes slow, or a total range of 41 minutes, while the percentage of correct predictions is only 3. The Chinese year is divided into twenty-four seasons, about 15 days apart, and depending on the sun's right ascension. Most of these, such as "little cold," "great cold," "rain water," "excited insects," etc., are not recognized by western science, but four of them—the equinoxes and solstices—are common to astronomy universal. According to the Chinese the sun is at the vernal equinox at 7h. 43m. P.M. According to foreign calculations the Pekin time for the same is 7h. 26m. P.M., making the Chinese 17m. slow. Their summer solstice is 29m. slow, autumn equinox, 49m. slow; winter solstice, 35m. slow.

We come now to a part of the almanac—the astrological—which the Celestials consult much oftener and consider much more important. Much of this is made intentionally obscure; the remainder, which makes up the body of the almanac, is intended as a practical guide in the common affairs of life. Prof. Harrington gives the following translation of this part for the first few days in the year:

"The first day is favorable for sacrifice and for entering school; at noon it is allowable to bathe. It is unfavorable for starting on a journey or changing residence.

"The second day is favorable for sacrifice and bathing. Unfavorable for starting on a journey, removing or practicing acupuncture.

"Third day, no indication. Fourth day, may receive and make visits and cut out clothes; at 7 A.M. may draw up contracts, barter, and make presents; may not go on a journey, nor break ground. Fifth day, may visit, bathe, shave, and clean up. May not plant and sow." And so it goes on for every day in the year. On the 17th one may be treated for illness, etc.; on the 22d it is allowable to pull down old houses, but drains and walls must not be dug till the 27th. Arrests should be made on the 25th, and as this is the only favorable day in the month for social purposes, it is a very satisfactory arrangement for criminals. It is advised to shave on the 5th, 23d, and 29th, and to bathe seven times in the month. The intervals between bath days are quite unequal, and the believers in the almanac must wait from the 5th to the 13th, and from the 14th to the 23d. There are four days out of the thirty on which one may cut out clothes, and the same number on which one may sweep and clean up. By such indications as these does the Chinaman guide most of the more important affairs of life. To the poorer classes the almanac is a subject of constant consultation, and they neither marry nor bury, nor do anything else, only when it advises.

GULF WEED.

MARY P. MERRIFIELD has contributed to *Nature* an able and exhaustive article on the subject of the "Gulf weed" growing in the "Sargasso Sea." This plant has attracted the attention and excited the interest of all voyagers across the Atlantic, from the time of Columbus to the present day, and has a history attached to it that renders it one of the most interesting vegetable productions of the ocean. This sea weeed, which has been floating about in mid-ocean for long ages, was called by Columbus and his followers "Sargago"—a term which botanists have modified into *Sargassum*, as a generic name, adding as a specific name *lacciferum*, in allusion to the numerous berry-like air vesicles with which the plant is provided, and which serve to buoy it up in the water. The plant has also been called *Fucus natans*, on account of its being found floating on the sea, and not attached to the shore or rocks; while to sailors it is known as "gulf weed," and that part of the North Atlantic situated between 22° and 36° N. latitude, where the plant most abounds, is called the Sargasso Sea. When the companions of Columbus first beheld the floating mass they became alarmed, as they thought it marked the limits of navigation; in fact, to the naked eye it seems substantial enough to walk upon. Patches of the weed are generally seen floating along the outer edge of the Gulf Stream. Sailors have observed that it always "tails" to a steady wind, so that it serves the mariner as a sort of anemometer, telling him whether the wind, as he finds it, has been blowing for some time, or whether it has just shifted and which way. Another peculiarity of the floating plant is that no other marine plant has ever been found growing on it or with it. A third peculiarity of the *floating* gulf weed is that it possesses neither root nor fruit; never in the Atlantic, or in other localities where it is met with, has it ever been found in fruit. The question then arises, how is the *floating* weed propagated? Dr. Harvey believes that the old frond, which is exceedingly brittle, becomes broken and that young shoots push out from the sides of the still living stem. The fact seems to be well established, however, from recent discoveries that the plant *when attracted to the land* in the Sargasso Sea and Gulf Stream, bears fruit. The present geographical distribution of the gulf weed is very curious. The presence of the plant in the warmer parts of the three great oceans, where means of communication are now impossible owing to conformation of land and barriers of icy waters that would prove fatal to it, remains yet to be accounted for. This can only be done by referring to a time when Mexico was submerged and the isthmus not yet in existence, and there was thus communication between the tropical Atlantic and Pacific; when open passages also existed between the Indian Ocean and the warmer parts of the Atlantic, and between the Indian and Pacific Oceans. The author concludes, then, from the facts adduced by geologists, that the migration of the gulf weed from one ocean to the other must have taken place previous to the most recent glacial epoch, and this period, according to Mr. Croll, cannot date back less than 240,000 years. She thinks, therefore, there are fair grounds for the opinion that many of the tropical algæ of the three great oceans are probably among the oldest of this class of plants (and algæ are supposed to have been among the very first productions of vegetable life), and that the gulf weed may be a "survival," still existing in health and vigor, of the marine vegetation of a very ancient period—as remote, at least, as the Miocene epoch, when the appearance and configuration of the country was, in all probability, different from what it is at the present day.

IN Europe steel and iron rails are now nearly the same price.

MURAL FOUNTAIN IN MAJOLICA.

From the Design of C. LACHER by FR. WUDIA, Graz.

GROUND of structural parts light yellow, shade of old ivory, ornament light and dark green, violet and red. Niche ground of frieze, shell of acroterial termination light and dark blue, framing ornament of the same, ornament flanking shafts of columns and basin yellow, figure subject light and dark yellow, brown, and violet. Niche semicircular and let into the wall, the basin below projecting. The cock in form of a rosette in center of ornament on pedestal of column.—*The Workshop.*

become intoxicated, stagger, and are unsteady in all their movements; act strangely and stupidly, losing their good 'horse sense' or common brute sagacity, in short, acting like fools, hence the Mexican name *Loco.*" The animals gradually get thinner and die, and death often supervenes suddenly. What is most remarkable, Dr. Kellogg says, with this and the Colorado loco (*Astragalus Lamberti*) is the permanence of the impression, often lasting many months, or even for years, half demented, until at length they die. The allied plant—*Tephrosia*—or "Devil's shoe string" of the South, although it stupefies and intoxicates, yet the impression soon wears off. We are often told by the advocates

to sit, set her with ducks' eggs, and let her hatch and care for the brood till they are able to take care of themselves. A hen will care for a brood of ducklings far better, ordinarily, than will an old duck. If the ducks think they have laid enough eggs, and show unmistakable signs of wanting to sit, put them into a convenient coop, put one of your most vigorous young drakes with them, and they will soon be willing to shell out eggs again, which should be set under hens as fast as convenient, so as to bring as many out at a time as possible, thereby lessening the cost of attending to them. A shallow tub, kept well filled with water, will afford plenty of bathing room for the ducklings until they are

SUGGESTIONS IN DECORATIVE ART.—MURAL FOUNTAIN IN MAJOLICA.—DESIGN OF C. LACHER, BY FR. WUDIA, GRAZ.

"LOCO" POISONS OF THE WEST.

IN volume six of the "Proceedings of the California Academy of Sciences," Dr. A. Kellogg gives a short account of certain vegetable poisons that have wrought great havoc with the herds of horses, cattle, and sheep in California and Colorado. Thousands of animals have been destroyed by plant poisoning. The noxious plants are leguminous—one of them, *Astragalus Menziesii*, which bears the popular names of "rattle weed," "pompous pea," "pop pea," etc., is pretty generally distributed throughout the State of California. It appears that horses and cattle do not like it at first, and will shun it so long as the pasturage remains good, but when other herbage is scarce, and hunger impels them, they will eat it; and in course of time they become excessively fond of this plant, which curiously enough produces a sort of intoxication. "After eating it," says the author, "horses

of temperance that man alone indulges in the debasing vice of drunkenness, but here appears to be a clear case against animals. Dr. Kellogg states that the brutes get to liking the plants more and more, being apparently as much infatuated as the drunkard for his bottle.

RAISING DUCKS.

AGAIN must we call the attention of breeders to the profit in ducks, when properly cared for, and when there are facilities at hand for breeding them properly. Many a farmer has realized far more from breeding ducks than he would obtain from his chickens, for they are very hardy, and lay remarkably well during some parts of the season. As soon as they commence to lay, the eggs should be carefully gathered and put away; as soon as a hen (not a duck) wants

two or three months old, and perhaps longer.—*Poultry World.*

ALFALFA.

IN Peru, the Alfalfa, or Chilian clover, is sown in beds, very level, from 25 to 40 yards square, with borders or embankments of a yard in width, to contain the water when irrigated, which is only a few days before cutting. The cutting is done with a coarse sickle, and very close to the ground, so that afterward, when the weeds have been pulled and the square raked clean, the soil appears quite bare. The grass grows very thickly and strong, three and often four feet high. It will not bear much water, an abundant irrigation or inundation rotting the tap-roots and causing the speedy death of the plants.